Engineering Library

The Engineer.

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VOL. CXLIV.—No. 3743] LONDON: FRIDAY EVENING, OCTOBER 7, 1927 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
1. CIRCULATING WATER PIPES for POWER STATION.
2. CRANES, STEAM, LOCO. TYPE, for Handling Coal, viz., Three 3-Tons and One 2-Tons.
Tenders due on the 18th October, 1927, for No. 1, and on the 21st October, 1927, for No. 2.
Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 6707

Air Ministry.
DIRECTORATE OF SCIENTIFIC RESEARCH.
A SCIENTIFIC OFFICER is REQUIRED for the Air Ministry's Scientific Research Staff, primarily for duty at the Royal Aircraft Establishment for design and research work in connection with high-speed supercharged internal combustion engines and with special reference to research on blowers.
Candidates are required to possess an Honours Degree in Engineering or equivalent qualifications, and should have had some years' experience in research on I.C. engines or on experimental work of an allied character. Candidates must also be medically fit for flying and be willing to fly as observer.
Salary £250, rising by annual increments of £20 to £350, and then by £20 to £450, with efficiency bar at £350, plus Civil Service bonus, per annum, giving a present total starting remuneration of £361 3s. per annum. The appointment will carry superannuation under the Federated Universities Superannuation Scheme, Government contribution being 10 per cent. of salary, individual contribution 5 per cent.
Preference given, other things being equal, to an ex-Service man.
Application should be made on a form to be obtained from the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants, to whom it should be returned, quoting reference No. A. 220, not later than 24th October, 1927. 6704

Appointments Board
OF THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.
Including :
ROYAL COLLEGE OF SCIENCE,
ROYAL SCHOOL OF MINES,
THE CITY AND GUILDS (ENGINEERING) COLLEGE, SOUTH KENSINGTON, S.W. 7.
EMPLOYERS REQUIRING MEN who have received a thorough training in the principles of Engineering and who have obtained the Diploma of the City and Guilds (Engineering) College are asked to make use of the services of the Board. Applications should be addressed to the SECRETARY. No fees are charged.
These men have received instruction (including practical work in the extensive and well-equipped laboratories of the College) in Civil, Mechanical and Electrical Engineering, including Mathematics, Physics, and Chemistry. Their training has been such that they are capable of specialising in any branch of Engineering that may be offered. 6673

Engineer Draughtsman REQUIRED, Singapore. Must have served articles and had seven years' Engineer's Office and Surveying experience. Capable preparing working drawings and specifications for steel and reinforced concrete structures. Knowledge earthworks, drainage scheme, sewage disposal desirable. Preference ex-Service men. Age under 40 years. Salary £140-7½-£200 per annum plus bonus (totalling approximately £210-£290) plus foreign service allowance 4300 dollars single, 5700 dollars married.
Apply, SECRETARY, W.B.5, Air Ministry, London, W.C. 2. 6501

University of London.
A COURSE of FOUR LECTURES on "HEAT TRANSFER IN RECIPROCATING ENGINES, INCLUDING INTERNAL COMBUSTION ENGINES," will be given (in English), with lantern illustrations by Prof. Dr. ADOLF NAGEL (of the Technische Hochschule, Dresden), at the INSTITUTION OF CIVIL ENGINEERS (Great George-street, Westminster, S.W. 1), on TUESDAYS and FRIDAYS, OCTOBER 11th, 14th, 18th, and 21st, at 5.30 p.m. At the first Lecture the chair will be taken by Sir Henry Fowler, K.B.E.
ADMISSION FREE, WITHOUT TICKET.
EDWIN DELLER,
6588 Academic Registrar.

County Borough of Brighton.
TO BOILER MAKERS AND OTHERS.
The Corporation invite TENDERS for the REMOVAL of two existing BOILERS and SEATINGS, the CONSTRUCTION of new BRICK SEATINGS, FLUES, &c., and the CONSTRUCTION, SUPPLY and ERECTION of two CORNISH BOILERS and FITTINGS, at North Road Baths, Brighton.
Specifications and drawings may be obtained from Mr. A. B. Cathcart, M. Inst. C.E., Waterworks Engineer, 12, Bond-street, Brighton, on payment of a deposit of Two Guineas, which will be refunded upon receipt of a bona fide Tender not subsequently withdrawn, and the return of the documents.
Tenders, marked "Tender for New Boilers, &c., North-road Baths," must be delivered to the undersigned at the Town Hall, Brighton, not later than 12 Noon on Thursday, the 13th October, 1927.
JAS. H. ROTHWELL,
Town Clerk.
Town Hall, Brighton,
September, 1927. 6590

County Borough of Brighton.
TO MANUFACTURERS OF SOFTENING PLANTS AND OTHERS.
The Corporation invite TENDERS for the SUPPLY and ERECTION of a BASE EXCHANGE SOFTENING PLANT, with Regenerating Tank, Electric Motor and Pump and appurtenant Plant at North-road Baths, Brighton. The plant to be capable of softening 20,000 gallons of water to zero hardness between regenerations.
Specifications and drawings may be obtained from Mr. A. B. Cathcart, M. Inst. C.E., Waterworks Engineer, 12, Bond-street, Brighton, on payment of a deposit of Two Guineas, which will be refunded upon receipt of a bona fide Tender not subsequently withdrawn, and the return of the documents.
Tenders, marked "Tender for Softening Plant, North-road Baths," must be delivered to the undersigned at the Town Hall, Brighton, not later than 12 Noon on Thursday, the 13th October, 1927.
JAS. H. ROTHWELL,
Town Clerk.
Town Hall, Brighton,
September, 1927. 6591

The Engineer

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PUBLIC NOTICES

Bombay, Baroda and Central INDIA RAILWAY COMPANY.
The Directors are prepared to receive up to Noon on Friday, 21st October, TENDERS for the SUPPLY of :—
TYRES FOR CARRIAGES AND WAGONS.
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).
The Directors do not bind themselves to accept the lowest or any Tender.
S. G. S. YOUNG,
Secretary.
Offices : The White Mansion,
91, Petty France, Westminster, S.W. 1,
5th October, 1927. 6696

Borough of Hove.
TENDERS are INVITED for PROVIDING and FIXING a LANCASHIRE BOILER at Hove Baths, King's Esplanade.
Further particulars may be obtained and specification seen at the Borough Surveyor's Office.
The lowest or any Tender not necessarily accepted.
Tenders, on forms supplied, addressed to the undersigned and endorsed "Tender for Boiler," will be received up to Five o'clock on Wednesday, the 26th instant.
W. JERMYN HARRISON,
Town Clerk.
Town Hall, Hove,
5th October, 1927. 6700

Corporation of Durban, Natal.
The Corporation of Durban, Natal, is prepared to receive TENDERS (from manufacturers only) for the SUPPLY and DELIVERY, Free on Board British Port, of SEVEN MILES of COMBINED PILOT and TELEPHONE CABLE.
The Consulting Engineers, to whom application for any further technical information may be made, are Messrs. Merz and McLellan, 32, Victoria-street, Westminster, S.W.
Specifications and forms of Tender can be obtained from, and sealed and endorsed Tenders must be delivered to, the undersigned on or before October 17th, 1927.
The charge for five copies of specification is £3 3s., which will be refunded on receipt of a bona fide Tender.
The lowest or any Tender will not necessarily be accepted.
By Order,
WEBSTER, STEEL and CO.,
36, Leadenhall-street, London, E.C. 3,
6660 Agents to the Durban Corporation.

PUBLIC NOTICES

Royal State Railways of Siam.
NOTICE.
Sealed TENDERS for the SUPPLY of LOCOMOTIVES with TENDERS and SPARES, B.E. 2471, will be received by the Administration of the Royal State Railways of Siam, Bangkok, until Fourteen o'clock on the 29th December, 1927, at which place and hour the Tenders will be publicly opened and read.
Blank Tender forms, general conditions, specifications, and drawings may be obtained from Messrs. SANDBERG, 40, Grosvenor-gardens, London, S.W. 1, upon payment of £3 per set, which sum will not be refunded.
Right is reserved to reject any or all Tenders, and to accept any Tender which is to the best interests of the Royal State Railways of Siam. 6677

State Electricity Commission of VICTORIA.
23-32, William-street,
MELBOURNE,
AUSTRALIA.
TENDERS are hereby invited for the MANUFACTURE, SUPPLY and DELIVERY for the Yallourn Brown Coal Works, Victoria, Australia, PLANT for the ELECTRICAL PRECIPITATION of BROWN COAL DUST in accordance with specification No. 27/83.
Copies of Tender form, specification, &c., will be available upon application to :—
THE AGENT GENERAL FOR VICTORIA,
Victoria House,
The Strand,
London, ENGLAND,
and
HERR J. KLITZING, BERGWERKSDIREKTOR,
Grube Marga,
Bei Senftenberg,
GERMANY.
CHARGE :—
£1 1s. for three copies of Tender form, conditions of contract and specification complete. This charge will be returned in the event of a bona fide Tender being received. Extra copies 10s. 6d. each, not returnable.
PRELIMINARY DEPOSIT :—
A preliminary deposit of £50 is to be lodged with Tender or at the Office of the Agent General for Victoria.
Tenders on prescribed form, properly endorsed and addressed, must be delivered at the Office of the Commission, Melbourne, not later than 12th December, 1927.
The Commission does not bind itself to accept the lowest or any Tender.
W. J. PRICE,
6607 Acting Secretary.

PUBLIC NOTICES

Abertillery and District Water BOARD.
SALE OF PLANT.
The above Board offer FOR SALE extensive ELECTRICAL, STEAM, and other PLANT, recently used in the construction of a large concrete masonry dam.
The following are some of the principal items :—
Generating Plant, consisting of No. 2 Ruston and Hornsby 230 H.P. Gas Engines and Producer Plants with No. 2 Metropolitan-Vickers 150 kW, 500-v. Dynamos.
No. 1 100 H.P. National Gas Engine and Producer Plant with No. 1 Bruce-Peebles 100 kW, 500-v. Dynamo.
No. 4 Anderson-Grice 2-ton 3-motor Electric Loco. Cranes.
No. 4 Steam Derrick Cranes, 4 and 5-ton.
No. 2, 14in. by 12in. Ingersoll-Rand Air Compressors with 500-volt Motors.
No. 1 W. D. Wild Haulage Engine and Motor.
No. 1 Double Concrete Hoist, 180ft. high, by Stothert and Pitt, with trussed steel chutes, hoisting winches, ¼-yard mixers, and 500-volt motors.
No. 1 Crushing and Sand Plant, by Hadfields, comprising No. 2 Jaw Breakers, 20in. by 10in.; 2 Hecla Disc Crushers; 1 Jaw Breaker, 16in. by 9½in.; 1 Pan Mill, Screens, Elevators and Shafting, driven by No. 3 75 H.P., 500-volt Motors.
No. 1 Lerner Drill Sharpener, by Ingersoll-Rand Co.
No. 1 Oil Furnace and Tank.
No. 7 Steam Locomotives, 3ft. gauge.
No. 1 5-ton Cableway, by Henderson, 1100ft. span, luffing head masts, electrically driven.
Together with many other items.
Further particulars can be obtained from the Board's Engineer, Mr. J. FRANCIS JUPP, M. Inst. C.E., Midland Bank Chambers, Newport, Mon. 6701

Civil Service Commission.
APPOINTMENTS VACANT.
APPLICATIONS are INVITED for THREE APPOINTMENTS in the Industrial and Commercial Property Registration Office as EXAMINERS of APPLICATIONS for PATENTS for Mechanical Engineering, Electrical Engineering and Chemical Inventions. Salary scales (pensionable) :—Married men, £150-350; women and unmarried men, £130-250 per annum; plus cost-of-living bonus in each case. At present the bonus on £150 is £88 16s. and on £130 is £81 18s. Candidates will be expected to give evidence of a good general education, particularly in mathematics and science. A knowledge of either mechanical engineering, electrical engineering or industrial chemistry will also be required. Age limits 25 to 40 years. Preference given to qualified candidates with approved Army service and to those having a knowledge of Irish. Women candidates must be unmarried or widows.
The appointments will be made by the Minister for Industry and Commerce on the recommendation of the Civil Service Commissioners, who will investigate the qualifications of the candidates with the assistance of a Selection Board appointed by the Commissioners. The latest date for receiving applications, which must be made on the prescribed form, is 19th October, 1927. Forms and full particulars may be obtained from the SECRETARY, Civil Service Commission, 39, St. Stephen's Green, Dublin.
17/8. 1681. W. H. CO. 6702

Municipality of Singapore,
STRAITS SETTLEMENTS.
SEWERAGE DEPARTMENT.
ASSISTANT ENGINEER.
ADVERTISEMENT.
The Municipal Commissioners of Singapore REQUIRE an ASSISTANT ENGINEER for the Sewerage Department, age from 26 to 35, well educated, of sound constitution and preferably unmarried.
Candidates must be qualified to design and construct sewers and sewerage details, including pumping mains, and must have special knowledge of the latest methods of the purification of sewage to the standard of the British Commission Report. The selected candidate must have had special experience on one or other of the various Activated Sludge Systems at work in this country, as the Singapore disposal works are being constructed on the bio-aeration system.
The appointment will be for three years with possible extension. The selected candidate must pass a medical examination as to his fitness for service in the Tropics. Free passage will be provided with half salary during the voyage out.
The salary offered is 5400 dollars for the first year with annual increments of 300 dollars, paid monthly, the value of the dollar being two shillings and fourpence sterling. There is at present no income tax. At this rate the salary for the first year would amount to £630, but a higher salary would be paid to a thoroughly experienced and well-qualified man. An allowance for such transport as might be required on duty would be granted.
Applications, stating age, birthplace, and giving details of education, training and experience, with particular reference to the qualifications stated above, and stating when free, accompanied by copies (not originals) of testimonials, also personal references, must be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 64, Victoria-street, London, S.W. 1, Agents for the Commissioners (from whom further information may be obtained), not later than Friday, 14th October, 1927. 6659

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PUBLIC NOTICES

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—
4702 HELICAL AND VOLUTE SPRINGS.
Tenders are due in on Tuesday, 25th October, 1927, by 2 p.m. Tender forms obtainable at above address ; fee One Guinea, which is not returnable.
The Directors do not bind themselves to accept the lowest or any Tender. 6697

North Wales Counties Mental HOSPITAL, DENBIGH.
The Visiting Committee are prepared to receive APPLICATIONS for the POST of ASST. ENGINEER at the Institution. Candidates must have experience of Electrical and General Engineering Work and Repairs, and applications are to state age, experience, and wages required. A moderate-sized house will be available free to a married man.
Applications, endorsed "Asst. Engineer," to be addressed to the undersigned not later than Saturday, October 22nd, 1927.
WM. BARKER,
Clerk to the Committee.
4/10/27. 6684

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, an ENGINEER for Calcutta Office of well-known Engineering Firm. Age under 25, single, and good education.—Address, stating salary required, 6680, The Engineer Office. 6680 A

WANTED, an ENGINE WORKS MANAGER for British-owned shipbuilding and marine engineering works abroad. Applicants should have previous experience of Works Management and good technical and general knowledge. Preference will be given to those having some Sea and Drawing-office Experience. Age not exceeding 35.—Address, "TECHNICAL," Wm. Porteous and Co., Glasgow. P3713 A

WANTED, CIVIL ENGINEERS, for Work with and promotion of modern Bituminous Road Materials in overseas countries. Must be public school men, age 30-35 years ; previous foreign or colonial experience an asset ; remuneration commensurate with education, experience, and ability.—Address, giving full details of training, experience, and salary expected, 6705, The Engineer Office. 6705 A

WANTED, COST CLERK for Midlands, Experienced in Costing of Motors, Controllers, Switchboards, and General Electrical Details ; capable for quick and accurate analyses of costs on batch production.—Address, stating age, experience, and salary expected, 6693, The Engineer Office. 6693 A

WANTED, Energetic REPRESENTATIVE, Well introduced amongst crane users, for Sale of Patent Grab. Must have had practical experience building and selling. State part., ref., and age.—Address, 6670, The Engineer Office. 6670 A

WANTED, ENGINEER, Fully Qualified with wide general mechanical and commercial experience in negotiating contracts, to Take Charge of London Office of old-established Firm of Engineers and Contractors.—Address full particulars as to age, experience, and salary required, 6679, The Engineer Office. 6679 A

A LARGE PROGRESSIVE FIRM, Engaged in the Light Engineering Trade in the Midlands, REQUIRES the SERVICES of a highly trained ENGINEER with experience in Machinery, Tools, &c., and with some knowledge of Foundry Management. Applicants should be capable of supervising a large organisation and accelerating production. Age about 35 years. Salary according to qualifications.—Apply, with full particulars and copies of references, to Box 902, Mundy, Gilbert and Troman, Advertising Offices, Birmingham. P3731 A

ASSISTANT TECHNICAL MANAGER REQUIRED. Must be conversant with Anti-friction Application ; capable correspondent.—Experience and salary required to Box L.E. 3522, Willing's, 30, King-street, London, W.C. 2. 6661 A

CHEMICAL ENGINEER REQUIRED, with Wide experience in the design, erection and maintenance of Chemical Plant for a large factory in the Midlands. Applications will only be considered from those having up-to-date knowledge and experience in modern factories employing a large number of workpeople. Age, experience, and salary required.—Address, 6586, The Engineer Office. 6586 A

CHIEF ENGINEER, MECHANICAL and ELECTRICAL, REQUIRED, having specialised knowledge of Extra High-tension Sub-station Equipment and Design.
Applications, stating age, nationality, salary required, full particulars of experience (mechanical and electrical), and where obtained, should be marked "Application, Private," and addressed to the MANAGER, The British Electric Transformer Co., Ltd., Hayes, Middlesex, England. 6583 A

ENGINEER, Unmarried, Age 25-30, REQUIRED for large Plantation Company in Dutch East Indies ; considerable practical experience Gas and Oil Engines (erection and maintenance) and of Constructional Work essential ; also experience of Electrical Machinery. Commencing salary £800 per annum and, if satisfactory, participation in profit-sharing scheme after first year. Free passage, bungalow accommodation, periodical full-pay furlough, and medical attendance.—Apply, with copies of testimonials and recent photograph, to Box No. 316, c/o Judd's, 47, Gresham-street, London, E.C. 2. 6665 A

GENTLEMAN REQUIRED by Large Steel Making Firm, to act as whole-time REPRESENTATIVE and SALESMAN in Lancashire. Thorough knowledge of steel trade essential.—Address, stating age, experience, and remuneration expected, P3750, The Engineer Office. P3750 A

HIGHEST GRADE SALES REPRESENTATIVE REQUIRED for modern Motor Body and Pressing Works, well recommended and having entree to motor car manufacturers essential. Permanent and remunerative position for man with necessary qualifications.—Address, stating age and full particulars of previous experience, 6678, The Engineer Office. 6678 A

MACHINE TOOL SALESMAN REQUIRED for Leeds and Sheffield districts ; thoroughly familiar with modern Machine Shop Practice. State full experience, age, salary, which will be treated confidentially.—Address, P3703, The Engineer Office. P3703 A

PRODUCTION ENGINEER WANTED for Locomotive Works in North of England. Experience of locomotive work not essential. Expert knowledge of modern Machine Tools and Methods of Production is required. State age, full details of experience, and salary required.—Address, 6692, The Engineer Office. 6692 A

STRUCTURAL ENGINEER FOR INDIA.—The SERVICES of a First-class MAN are REQUIRED. Must be good designer and capable of carrying through contracts for Steel-framed Buildings, Bridges, &c.; drawing-office and workshop experience, should be A.M.I.C.E. or possess equivalent professional qualifications. Good salary and prospects. Age 30 to 35.—Write, sending full particulars of qualifications and experience, to Z.H. 325, care DEACON'S ADVERTISING OFFICES, Fenchurch-avenue, London, E.C. 3. 6703 A

SUPERINTENDENT ENGINEER WANTED by a Large Concern to Reorganise Production in their various works on progressive economical lines ; only an engineer of experience capable of producing evidence of success in a similar capacity will be considered.—Address, giving fullest details of past record in strict confidence, 6698, The Engineer Office. 6698 A

ARNOLD BOOKS

NEARLY READY.

EXAMPLES IN THE STRENGTH AND ELASTICITY OF MATERIALS.

By G. W. BIRD, A.M.I. Mech. E., A.M.I.E.E., Head of the Mechanical Engineering Department, Municipal Technical School, St. Helens. 191 pages, 105 diagrams. 10s. 6d. net.

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A Treatise on the Theory of Stress Calculations for Engineers.

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Lecturer in Applied Mechanics at the Royal Naval Engineering College, Keyham.
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Large 4to (12in. × 9½in.). 8s. net.

HYDRAULICS.

For Engineers and Engineering Students.

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The Engineer.—"It may be recommended as being at once sufficiently elementary, theoretical, practical and advanced to be both a sound text-book and useful book of reference."

ELECTRIC TRAINS.

By R. E. DICKINSON, B.Sc., A.M. Inst. C.E., A.M.I.E.E., Works Manager, Electric Train Repair Shops, New South Wales Government Railways.
xii + 288 pages, 139 diagrams. 16s. net.

LONDON EDWARD ARNOLD & CO. 41 & 43, MADDOX ST., W.

SITUATIONS OPEN (continued)

(a) TWO FIRST-CLASS BRIDGE and CONSTRUCTIONAL STEEL WORK DRAUGHTSMEN REQUIRED for Technical Office, Buenos Aires, Argentina. Commencing salary 400.00 dollars Argentine paper currency per month (approx. £400 p.a.), after one year's service 450.00 dollars per month, and on completion two years' service 500.00 dollars per month.
(b) TWO QUANTITY SURVEYORS REQUIRED for Technical Office, Buenos Aires, Argentina, capable preparing bills of quantities, working up prices, preparing specifications and contracts, with good knowledge building construction. Comencing salary 400.00 dollars paper currency per month (approx. £400 p.a.), after one year's service 450.00 dollars per month, and on completion two years' service 500.00 dollars per month.
(c) TWO ASSISTANTS for CIVIL ENGINEER'S DEPARTMENT (unmarried) REQUIRED for Argentina. Sound technical education and engineering training necessary. Commencing salary 380.00 dollars Argentine paper currency per month (approx. £380 p.a.), with an increase of 50.00 dollars per month on rendering satisfactory examination in the Spanish language.
Applications, in brief, outline of technical education, training and experience, without testimonials, for the above positions to be addressed to FOX and MAYO, Consulting Engineers, 155, Dashwood House, Old Broad-street, London, E.C. 2. 6683 A

DRAUGHTSMAN, Thoroughly Experienced in Cable Machinery and General Plant Work, REQUIRED by CALLENDER'S CABLE and CONSTRUCTION CO., Ltd., Belvedere, Kent. None but fully qualified applicants will be considered. 6608 A

DRAUGHTSMEN WANTED, Thoroughly Experienced in the design and lay-out of modern coal and ore-handling plant.—Write, stating age, full particulars of experience, and salary required, to Box 485, Sells, Fleet-street, E.C. 4. 6708 A

EXPERIENCED DRAUGHTSMAN DESIGNER WANTED for Engineering Firm, N.W. London. Knowledge of Printing Machines essential. Only really capable men need apply with full particulars as to experience, salary, age, &c.—Address, 6667, The Engineer Office. 6667 A

JUNIOR DRAUGHTSMAN, Also Able to Do Stenographical Work, REQUIRED by Engineering Company.—Address, 6672, The Engineer Office. 6672 A

JUNIOR ENGINEERING DRAUGHTSMAN REQUIRED by Reinforced Concrete Firm. State age, experience, and salary required.—Address, 6663, The Engineer Office. 6663 A

JUNIOR JIG and TOOL DRAUGHTSMAN WANTED for works in N. London district. Applicants must have at least three years' experience. State age, experience, and salary required.—Address, P3729, The Engineer Office. P3729 A

STRUCTURAL DRAUGHTSMAN WANTED for Engineering Works in Bombay, able to design, make working drawings and take out quantities. Salary commencing Rs. 500 per month on 5 years' agreement.—Write, giving full particulars of experience, age, and whether married or single, to Box Z.T. 292, c/o DEACON'S ADVERTISING AGENCY, Fenchurch-avenue, London, E.C. 3. 6671 A

WANTED, EXPERIENCED FOREMAN for Bridge and Constructional Steel Works ; must have up-to-date knowledge of high class work. Age not over 40. Good references essential.—Apply, with full details of experience, to 2000, Sharp and Co., 14, Exchange-square, Glasgow. P3721 A

ELECTRIC AND STEAM CRANE WORK.—Thoroughly experienced FITTING and ERECTING SHOP FOREMAN REQUIRED by Midland Manufacturers of Electric and Steam Cranes, Telphers, Conveyors, Elevators, &c. Preferably a young technically educated man, not over 40, who has served his whole time at this class of work. Good position for the right man.—Address, P3740, The Engineer Office. P3740 A

FOREMAN ENGINEER REQUIRED to Supervise Erection of large Well Pumps and Engines in England. Only men with previous experience of this class of work need apply. Give full particulars of plants erected, age, salary required, &c.—Address, 6461, The Engineer Office. 6461 A

TWO FITTERS REQUIRED for Erection on Site of Heavy Pumping Machinery and Engines. Give full particulars, including age, wage and class of plants previously engaged upon.—Address, 6462, The Engineer Office. 6462 A

SITUATIONS WANTED

A BRITISH ENGINEER (Hydro-electric), with exceptional experience and university training, now returned from abroad on completion of important power plant construction, DESIRES FOREIGN APPOINTMENT on Civil or Electrical Branch. Speaks four languages, has own car, and is thoroughly expert and reliable.—Address, P3739, The Engineer Office. P3739 B

AS RESIDENT ENGINEER on Heavy Bridge, Dock or Railway Work. Highest references.—Address, 6442, The Engineer Office. 6442 B

AUTOMATIC ELECTRICAL REFRIGERATION.—Engineer-Designer, expert in all systems, OFFERS SERVICES to sound Engineering concern desiring development this branch ; 20 years designing, works management. Accept responsibility for production on modern methods.—Address, P3754, The Engineer Office. P3754 B

CHARTERED ELECTRICAL ENGINEER, A.M.I.E.E., A.M.I.M.E., present disengaged, DESIRES PERMANENT APPOINTMENT at home or abroad. Has had considerable experience in A.C. and D.C. installations and construction of boiler plant, also commercial and contracting. Good organiser and can produce good credentials.—Address, P3741, The Engineer Office. P3741 B

COMMERCIAL ENGINEER, Thorough Technical mechanical and electrical knowledge and extensive business experience, sales organisation and control of staff, home and abroad (six years in India), DESIRES APPOINTMENT. Highest references. — Address, P3752, The Engineer Office. P3752 B

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

The Late Professor Einthoven.

Although Professor Willem Einthoven, whose death occurred at the age of sixty-seven at the end of last week, had for the past forty-two years occupied the Chair of Physiology at Leyden University, his fame will live long in the annals of physics if for no other reason than for the invention of the string galvanometer associated with his name. That instrument was invented for the express purpose of studying the electrical phenomena of the heart, a subject to which Einthoven gave much of his attention, and in connection with which his discoveries led to his being awarded the Nobel Prize for Physiology and Medicine in 1924. The Einthoven galvanometer makes use of a fine glass or quartz fibre coated with a conducting layer of silver, gold or platinum, or of a fine wire of these metals or of tungsten, copper, phosphor bronze or platinum. This fibre or string carrying the current to be measured is placed in an intense magnetic field derived from an electro-magnet and is kept in tension by a spring; the adjustment of the tension alters the frequency and damping of the movement. When a current passes through the fibre, the fibre moves at right angles to the magnetic field and its movement is observed through a microscope or is recorded by projecting the image of the string on to a photographic film. The instrument is of a very sensitive nature, and has been used for many physical purposes as well as for the original physiological research for which it was designed. With its aid it has been found possible to record, photographically, alternating or pulsating currents, such as those received in wireless telegraphy.

Airship Engines.

In a report issued at the end of last week by the Committee of Public Accounts, a considerable amount of comment is made upon a new form of airship engine and the manner in which the Air Ministry became responsible for its development. The engine referred to is one designed to use surplus hydrogen as fuel. It is not mentioned by name, but it is clear that the reference is to the experimental engine produced and studied by Mr. Ricardo. This engine was developed on behalf of the Airship Guarantee Company, and it was at one time hoped that it would be employed in the 5,000,000 cubic foot airship R 100, which that company is building. In January, 1926, the company, according to the Committee's report, intimated to the Air Ministry that it had expended about £28,500 on the development of the engine, and had been compelled to stop work on it for financial reasons. It was suggested that the Ministry should continue the development of the engine and repay the expenditure already incurred by the firm. On the recommendation of the Ministry's experts, the Air Council on March 31st, 1926, purchased the engine, together with the patent and design rights owned by the company, for the sum of £10,500. At that time it was contemplated that further expenditure would be necessary to modify the engine in order to eliminate certain failures that had already occurred before it could be put through further tests. The Committee, however, was informed that beyond working out certain modifications of design, no work has been done on the engine since its purchase. Actual tests, it is hoped, will be carried out in the course of the present financial year. The Committee, although it admits that it is unable to express an opinion on the technical value of the engine, views the transaction with considerable misgivings. It cannot understand why, once the engine was purchased, its development was not pushed on at a greater rate. It trusts to hear that as a result of the trials to be held, the State has got value for the expenditure. It does not seem to be known to the Committee that scientific development cannot be worked to a time limit, nor would it appear to have occurred to it that to acquire for £10,000 odd, experience and knowledge gained at an expenditure of £28,000 may merit description as an excellent bargain.

A High Pressure Cargo Liner.

There was launched at the Central Shipyard of William Gray and Co., Ltd., West Hartlepool, last week, the Ellerman liner City of Canberra, which is of especial interest by reason of the fact that she will be equipped with high-pressure reciprocating steam engines. The new ship has a length of 453ft., with a deadweight carrying capacity of 10,800 tons, and a sea speed of 13½ knots. The machinery, which has been built at the Central Marine Engine Works of the builders, will comprise quadruple-expansion, inverted, direct acting, surface-condensing steam engines. The cylinders are 25½in., 37½in., 54in. and 78in. bore, with a stroke of 54in. Steam will be supplied from four main boilers designed for a working pressure of 265 lb. per square inch, and a total temperature of 560 deg. Fah. The boilers will work under forced draught and will be fitted with air preheaters, so that the air for combustion will be delivered to the furnaces at a temperature of about 300 deg. Fah. The installation, which has been built to the designs of Mr. Maurice S. Gibb, who is the managing director of the Central Marine Engine Works, and this year's President of the North-East Coast Institution of Engineers and Shipbuilders, is expected to give exceptionally economical results. We understand that the owners of the ship are building two further cargo liners of the same type, one of which will be propelled by oil engines and the other by geared turbine machinery. The comparative performances of the three vessels when they are completed should prove to be unusually interesting.

Conference on Methods of Coal Analysis

The British Engineering Standards Association announces the calling of a conference resulting from a request of the Committee of the Privy Council on Scientific and Industrial Research that British national standard methods of coal analysis should be adopted. It is suggested that report No. 7, "Methods of Analysis of Coal," as drawn up by the Fuel Research Board, should be used as a basis for the preparation of a British standard specification for national use. The conference is being called for the purpose of ascertaining if there is a consensus of opinion in favour of setting up a B.E.S.A. Committee to deal with the subject, and delegates have been invited from all interested bodies to attend. The Committee of the Privy Council states that the question of methods of analysis is one of increasing importance, owing to the growing tendency to purchase coal to specification. This tendency is especially marked among foreign purchasers. The Committee considers that the national adoption of standard methods of analysis would be of considerable advantage, both to the producers and the users of coal.

The Parsons Marine Steam Turbine Co.

The report of the Parsons Marine Steam Turbine Company, Ltd., for the year ended June 30th, 1927, which is to be submitted to the thirtieth annual meeting of the company at Wallsend on Tuesday next, October 11th, is a very satisfactory one. One of the principal orders upon which the firm has been engaged during the past year has been the construction of the propelling machinery for five geared turbine vessels for Canadian Pacific Steamships, Ltd., which is now ready for fitting aboard. The company has also constructed the propelling machinery for H.M. cruiser Suffolk, which ship has carried out satisfactory official speed trials. We note from the report that the Clyde high-pressure turbine passenger steamer King George has been running daily during the summer season, and has shown an economy in coal consumption of 30 per cent. compared with similar vessels in the same service. The trials, which were carried out towards the end of last year, gave results which, it is stated, agreed closely with those anticipated, and they are held to confirm that on larger powers the increase in efficiency claimed for higher steam pressures and temperatures can be obtained. The experiment has, it is remarked, not only demonstrated the practicability of the application of high temperatures and pressures to marine work, but it has also shown that there are no difficulties in such installations which cannot be met by making suitable provisions. Several vessels which are being constructed by the company's licensees will be fitted with high-pressure turbine machinery.

The South-East England Electricity Scheme.

During the last few days considerable interest has been aroused by the publication of the details of the South-East England electricity scheme, 1927, which the Electricity Commissioners have transmitted to the Electricity Board for adoption. The scheme embraces the counties of London, Middlesex, Hertford, Essex, Kent, Surrey, Berkshire, Buckinghamshire, Bedfordshire, Cambridgeshire, Huntingdonshire, and parts of the counties of Sussex, Hampshire and Suffolk. The area includes the electricity district of the London and Home Counties Joint Electricity Authority, which in turn contains the whole part of the areas of supply of 93 authorised undertakings. In all, 165 authorised undertakings come within the ambit of the scheme. The East England area contains 135 public supply generating stations and 17 traction stations. The stations determined to be selected stations, including the two projected stations at Battersea and Chiswick, are Barking, Brimsdown, Deptford East, Deptford West, Hackney, Groveroad, Stepney, Willesden, Bow, Bankside, West Ham, Brighton, Peterborough, Battersea and Chiswick. The scheme also contemplates that a new generating station will have to be established at Little Barford, near St. Neots, to supplement the resources in the northern area, and that prior to 1940 two additional stations, each containing as a first stage 200,000 kilowatts of generating plant will be required. Other stations needed for the purpose of the scheme to supplement the operation of selected stations, under temporary arrangements between the Central Electricity Board and their respective owners, are Battersea, Woolwich, St. Marylebone, Blackwell Point, St. Pancras, Poplar, Walthamstow, Wandsworth, Shoreditch, Croydon, Willesden, Brimsdown, Ipswich, Luton, and Gravesend. The scheme contemplates the construction of an overhead transmission line round the South of London interconnecting Barking, Croydon, and Willesden, which in turn will be connected with the base load stations at Deptford, Battersea, and Chiswick. This line will be the main artery for the transmission of energy from East to West and *vice versâ*. The base load stations will be inter-connected with the principal secondary stations, which will generally be worked as two-shift stations, and also with the other stations mentioned, which will be operated as one-shift stations. The scheme is expected to reduce the average price of electricity in the area involved to 1.25d.

A Large Aerial Ropeway.

In a journal note of May 13th, when dealing with the Nag Hammadi Barrage over the Nile, we made brief reference to the cableway which will be erected from bank to bank of the river, and which will be used by Sir John Jackson, Ltd., the contractors, for the transport of material and men during the actual building operations. The cableway, which it is stated will be the largest aerial cableway in the world, will be supplied by John Henderson and Co., Ltd., of Aberdeen. It will comprise five ropeways of the luffing type, which will span 3100ft. The total length of steel wire rope which will be required will, we understand, amount to 22½ miles. The cableway is to be capable of dealing with five ton loads at a hoisting speed of 250ft. per minute, and a travelling speed of 1250ft. per minute. In order to support the cableway at the desired height masts 182ft. high will be required. We are given to understand that the cableway at the Bradford Waterworks has the largest span of any yet built, namely 2060ft. in length, which will be exceeded in the case of the Nag Hammadi installation by over 1000ft. An illustrated account of the Nag Hammadi Barrage will be found in our issue for September 2nd.

New Motor Vessels for the Clyde.

At the thirty-third annual meeting of the Prince Line, which took place in London on Tuesday, October 4th, Sir Frederick W. Lewis, Bart., announced that contracts for four new 16-knot motor vessels had been placed on the Clyde. He referred to the assistance of the Trades Facilities Committee in agreeing to guarantee an amount of approximately 50 per cent. of the cost of the vessels under the Treasury scheme. Even so, Sir Frederick went on to say, the board of directors had made a considerable sacrifice in order to place the work in Great Britain. Tenders had been received from first-class continental builders, which, if they had been accepted, would have shown a saving of round about £140,000. It will be recalled that on the previous occasion five ships for the Prince Line were ordered from German builders at prices which showed a saving of £300,000 over the lowest British tenders. Happily, since that time the closer relationship and better understanding between shipbuilders and the shipbuilding trades unions have considerably narrowed down the apparent differences between British and continental prices. Two of the new vessels are to be constructed by Lithgows, Ltd., at Port Glasgow, and two by Napier and Miller, Ltd., of Old Kilpatrick. The oil engine propelling machinery will be supplied by John G. Kincaid and Co., Ltd., of Greenock. Sir Frederick Lewis said he believed that both the shipbuilders and engine-builders had endeavoured to do their utmost to meet the competition with which they were faced.

Italian Naval Programme.

Important modifications are announced in the Italian programme of naval construction. This programme provided originally for five cruisers of the 10,000-ton class, the first two of which, Trieste and Trento, are already well on the way to completion. It now appears to be doubtful whether the three remaining ships will be laid down. In any case precedence is to be given to four cruisers of a smaller class. Their displacement is to be 5300 tons, and they are designed for the remarkable speed of 36 knots, a velocity not hitherto attempted in vessels of the cruiser type. They will be armed with 6in. guns, mounted in pairs on the centre line. It is hoped to have these four ships at sea by 1929–30. The existing programme of lighter craft has been expanded. It now includes twelve destroyers, or scouts, of 2000 tons and 38 knots, each mounting six 4·7in. guns and six torpedo tubes. These boats will also be equipped for minelaying. Their completion will raise the Italian destroyer flotilla to a strength of about eighty boats, the majority being of fairly modern construction. Other vessels projected include a large aircraft carrier of high speed, designs for which are now in preparation. The carrier Giuseppe Miraglia, a former merchant vessel, was completed last year, but is now undergoing further alterations. She has a displacement of 5000 tons, with turbine machinery designed for 21·5 knots, and is able to carry twenty aeroplanes. Eight new submarines, the largest ever built in Italy, have been authorised, but apparently not yet begun. The current Navy Estimates provide 400,000,000 lire for new construction and armaments. It is stated that the cost of naval construction in Italy has been substantially reduced in recent years.

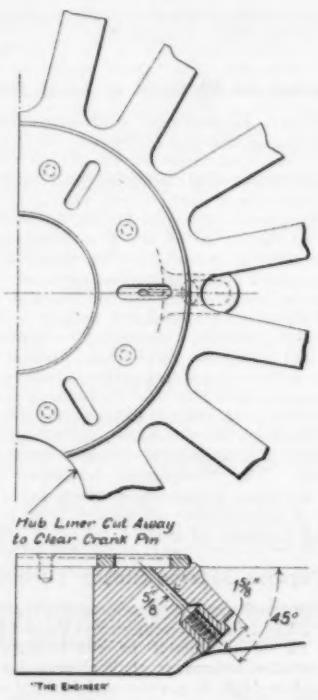
An American Diary.

No. XI.*

The Illinois Central Railroad.

If you are interested in railways and locomotives it is well, when you are in Chicago, to call upon Mr. R. W. Bell, General Superintendent, Motive Power, Illinois Central Railroad, at his office in the Depôt. He will chat with you about many things, from graft to locomotives and electric railways, will provide you with drawings of anything you fancy, and will introduce you to Mr. Moody, his chief draughtsman, and to Mr. Nash, who is, what we should call here, a works manager. Mr. Moody will go into the question of locomotive valve gears with you—or, for that matter, any other locomotive question—and will tell you how the Illinois Railroad has given up the Young valve gear, which gave a travel of 9in., because it has been found possible to develop a Walschaerts gear that gives 8⅝in., which is enough; and Mr. Nash will arrange to meet you at 8.30 on the next morning to show you the locomotive running sheds, and take you for a run on the suburban electric railway. Just as there is, in its way, nothing worse in America than the "Subway" of New York, unless it be the appropriately named "L"—the elevated railway—so there is nothing better of its kind than the suburban electrification of the Illinois Central system. Of the Urban railways of New York, it is impossible to speak with moderation. They are unworthy of a magnificent city; both are dirty, ill-kept, and in their station arrangements crude and out of date. They provide rapid transit, but that is the only good thing that can be said for them. The "Elevated" in any city—most of the big cities have them—is an absolute abomination. It is excessively noisy, the steel columns upon which the road is supported interfere with road traffic, and the whole contraption is such a disfigurement that any street through which it runs becomes a social outcast. Heaven defend us from their like ever defiling London! The Illinois electrification is as different as possible. It is admirably organised and is more like an English electric railway than any other railway we had the fortune to see in America. The trains are clean and comfortable, the stations neat without being extravagant, and the service frequent. When we say that it is as good as the suburban electric services of London, we give it the highest praise we know. Of course, it is new and the railways of New York—we mean the "Subway" and the "L"—are old, and, we admit, there is some difference in the nature of the services—one is urban, the other suburban—but we are still left wondering why New York tolerates the dirt and ugliness of its system when, if it cannot take example from other American cities, it may study the urban railways of London with their clean stock and clean stations. If London could make the tremendous change which has been effected in the Metropolitan and District railways in recent years; if London can march with progress, surely New York should be able to do so.

The Illinois running shed at Chicago is a round house. It presents no remarkable features, and it is rather in what it contains than what it is that the chief interest lies. Yet there is one little detail worth noticing. At the outer end of each running way, a shallow pit is fashioned, and covered with stout boards. There are no stops of any kind at the rail ends, but if an engine is inadvertently driven a little too far, the front wheels break the boards, fall into the pit and arrest further movement. A simple and effective plan.



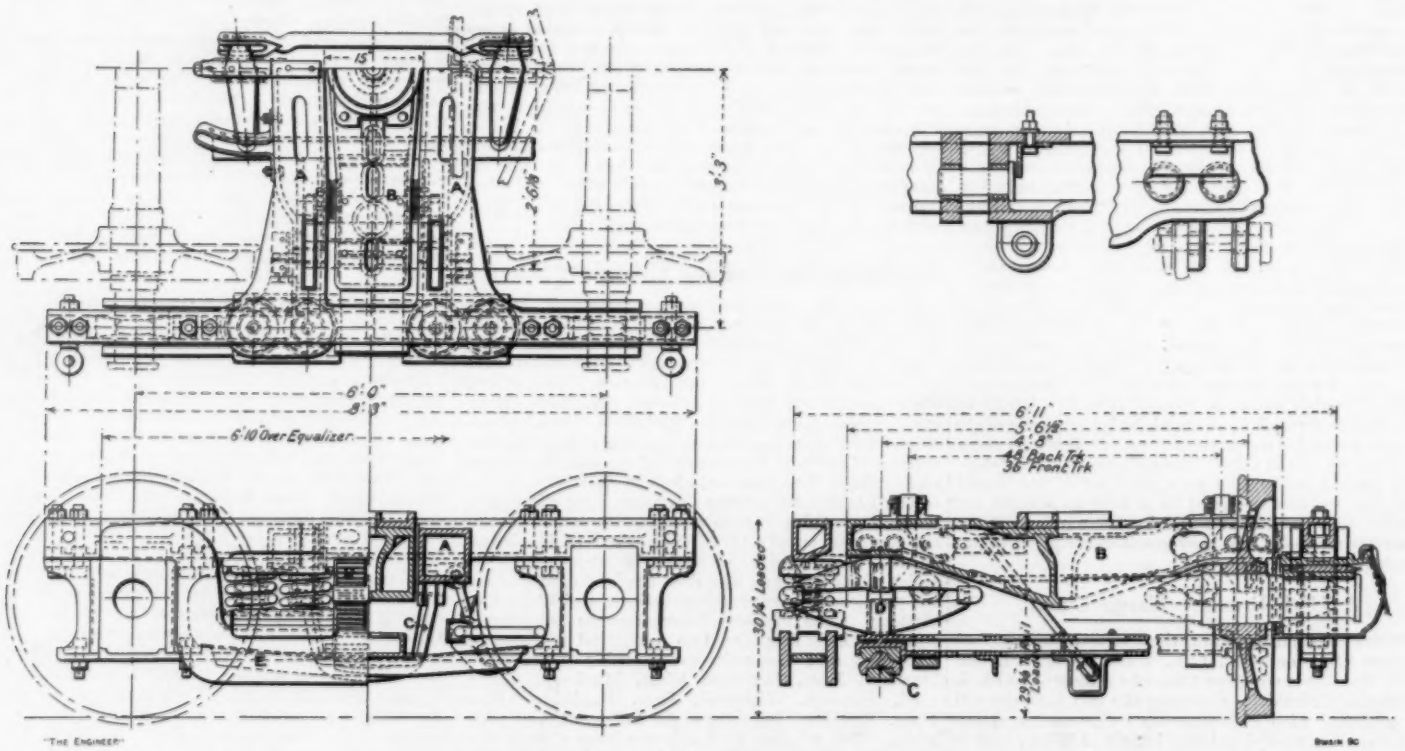
CHRISTMAN HUB LINER AND LUBRICATOR

Wandering round this round house and the repair shops, with Mr. Nash, we saw not only many locomotives, but details of rolling stock which interested us. For example, we noticed that many of the locomotive wheels were fitted with the Christman hub liners and lubricators. Above is a sketch which shows the arrangement. A boss, it will be seen, is formed upon the hub to take a grease lubricator. To the inside of the hub a liner with radial slots is screwed. The grease enters one of the slots and is soon picked up by the others, so that after a short time all are full. The object is to reduce the friction between the face of the hub and the outer face of the brass. Mr. Nash told us that it had proved very beneficial in service. In this country a device of the kind is unnecessary, because here we use oil axle-boxes and the oil works its way over the faces, but in America, we believe, grease is ordinarily used, and it does not spread so readily.

The springing arrangement of four-wheeled trucks for tenders, coaches, motor stock, and so on, attracted our attention, and Mr. Bell has given us a number of drawings of it from which we select a typical example for reproduction. It shows the general arrangement for a tender truck. The main frame consists of an H-shaped steel casting. The cross bar A A A of the H is double, and the bolster B fits with lots of freedom between the two parts. From each end of the cross bar of the H hangs a bracket C, and between the two brackets stretches an equalising bar. Between the ends of the bolster and the ends of the equalising bar there is a double-elliptical plate spring D at each end. This system, it will be seen, gives spring-controlled lateral suspension. Now, looking at the half elevation on the left of the drawing, it will be seen that a deeply bent bar E—it is a double bar, as a matter of fact—extends from the top of one axle-box to the top of the other. Between this bar and the main frame there are, at each end, two groups of helical springs. This system gives longitudinal suspension. We observed that this arrangement is very largely used by the Illinois Central, and is gradually replacing other forms of suspension as it has proved very satisfactory in all respects. Although a somewhat similar arrangement may be seen in this country, we believe that an independent spring-supported bolster is not used here.

Amongst other interesting things which we noticed were numbers of cast iron wheel centres, with tires in one piece, for wagons and coaches. They are of the disc form and are cast with the tread against a chill which makes it so hard that machining is impossible. These wheels are very cheap and when worn are thrown away. There is at present no intention to grind the treads.

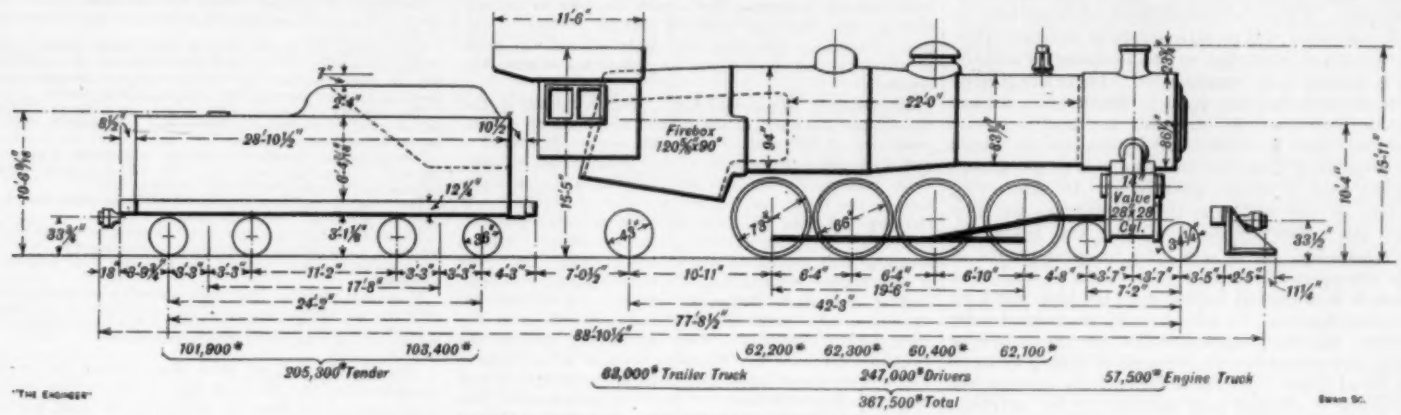
Amongst recent locomotives of the Illinois Central Railroad we must mention two at least. They are both eight-coupled engines, and the leading particulars are given on the weight diagrams on the opposite page. The 4-8-2 engine, with 6ft. 1in. wheels, cylinders 28 by 28, and a boiler pressure of 200 lb., has a tractive effort of 51,121 lb., say, 22·8 tons. Its grate area is 75·4 square feet, the heating surface, including two syphons, 4709·5 square feet, and its superheater surface is 1227 square feet. The tender carries 18 tons of coal and 10,000 gallons of water. The total weight, engine and tender, loaded, is over 255 tons.



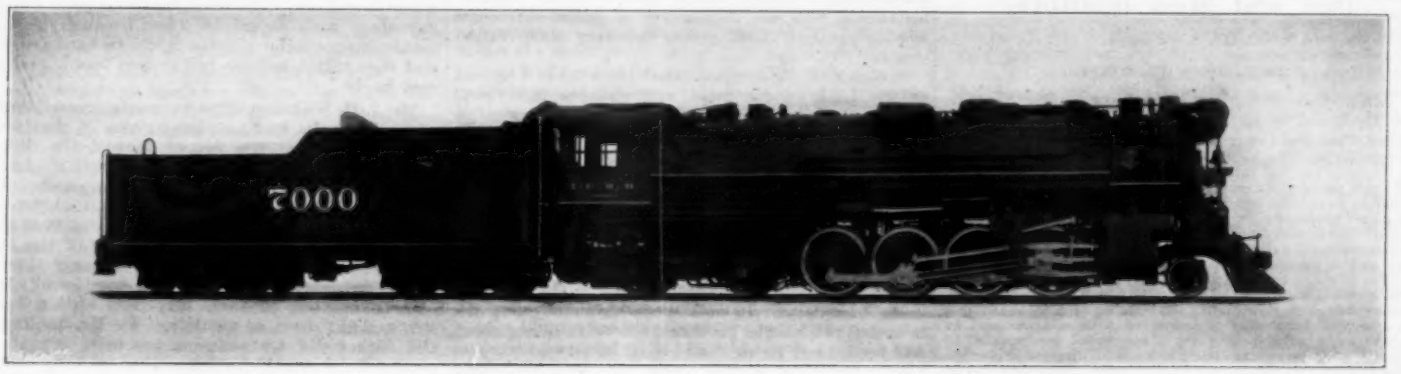
SPRINGING ARRANGEMENT OF FOUR-WHEELED TRUCK

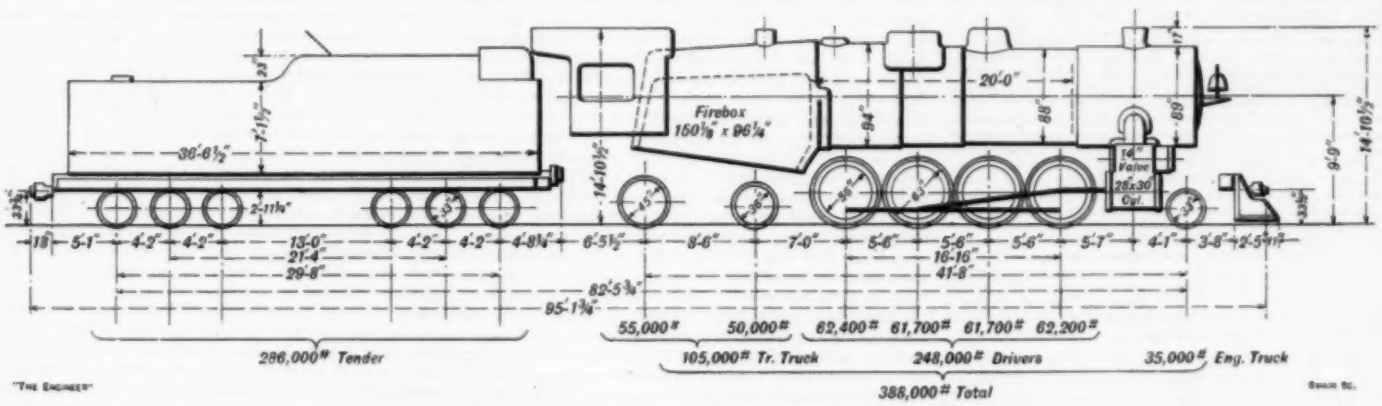
* No. X. appeared September 30th.

The other locomotive, of which a photograph is reproduced as well as the weight diagram, is a still bigger machine, weighing, with tender, just 300 English tons. It has two cylinders, 28 by 30, 5ft. 3in. driving wheels, and a steam pressure of 240 lb. Its tractive effort is therefore 69,400 lb., or nearly 31 tons. But it is fitted with a booster, and with its help can develop a total tractive effort amounting to more than 36 tons. The fire-box of this huge machine is 12ft. 6in. long by 8ft. wide, and the grate area is 100 square feet. The fire-box is, of course, of the wide type, which is almost universal in America, and the arrangement of the wheels on the trailing bogie to suit it will not escape attention. The total heating surface is 5164 square feet, and the superheater surface 2111 square feet. The rigid wheel base is only 16ft. 6in., as against 19ft. 6in. in the other engine, and the boiler, between tube plates, is correspondingly shorter. The driving axle load on the drivers is getting on for 28 tons in both engines. Like all big American locomotives, this engine, as the engraving shows, is covered externally with gadgets. What they all are, we are unable to recall, but we know that the cylinder just above the fire-box door is a feed-water heater. The air-brake pumps are on top of the cow-catcher.

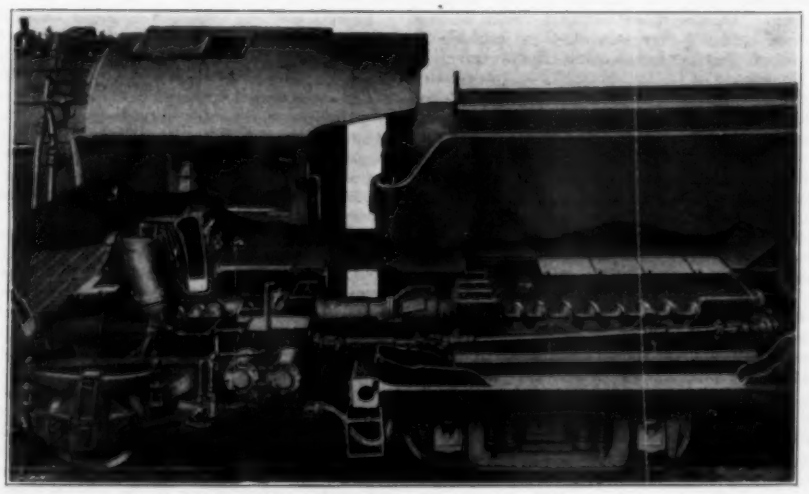


ILLINOIS CENTRAL R.R.—EIGHT-COUPLED LOCOMOTIVE





ILLINOIS CENTRAL R.R.—EIGHT-COUPLED ENGINE NO. 7000



DU PONT SIMPLEX STOKER

In an earlier page of this Diary it was said that when the grates of American locomotives exceeded 70 square feet automatic stokers were used. It is so in this case, for both these engines, like many more on the Illinois Central, are fitted with the stoker known as the du Pont Simplex. The Standard Stoker Company, Inc., which makes this type of stoker, issues a book of instructions for its use, and from this book we borrow a pictorial section, because it makes the apparatus clear at a glance. A small horizontal steam engine, the two cylinders of which can be seen in the picture, drives, through a Cardan shaft and appropriate gearing, a screw conveyor. The conveyor lies in a trough open at the top, but closed, as may be needed by plates. Through an opening coal is shovelled into it, and is carried forward by the screw between crusher plates, which break it into small pieces. Still moving forward, it is pushed up a bend and falls over the edge down an inclined housing or is propelled by steam jets in any direction which the fireman may desire. The stoker is described as "rugged" by its makers, and rugged it is. Everything that can be cast is cast—in iron or steel—and left as far as possible just as it came from the fettlers. There is no attempt at finish anywhere. The engine, which is entirely boxed in and runs in oil, is the simplest possible two-cylinder affair. Its speed is controlled by a throttle valve, and to reverse it a piston valve is employed

to change over the steam and exhaust passages. As reversing is only used momentarily to relieve a coal jam in the conveyor, this crude method is adequate. What the consumption of steam may be we do not know, but it can scarcely be inappreciable, for the cylinders are 6in. or 7in. in diameter and the jets have also to be remembered. There are sixteen of them, and they are $\frac{1}{16}$in. in diameter. All are not open all the time, but some are, and as in one row three jets are controlled by one valve, whilst the remaining four jets are also in a single group, a good deal of steam must pass. An interesting feature of the design is that it delivers the fuel very little above grate level and well below the arch opening. It is said that in consequence of this arrangement there is less waste of coal than when it is delivered higher up. On this point we have no figures. It will be seen that the tender portion and the engine portion of the conveyor trough are joined by a short length of tubing with two spherical joints. At the centres of the spheres, the conveyor is divided and coupled up by universal joints.

(To be continued.)

Iron and Steel Institute.

No. III. (*Conclusion*).*

Nickel-chromium Steels.

The first paper read on Thursday morning, September 22nd, was by Mr. H. A. Dickie on "Magnetic and Other Changes Concerned in the Temper-brittleness of Nickel-chromium Steels."

In this paper it is shown that no double effect similar to that obtained in specific volume and in hardness is apparent in the magnetic properties or in the resistivity of nickel-chromium steels. The results show that the magnetic properties are modified by cooling the steels slowly from the tempering temperature, and that the magnetic state of the intermediate condition is similar to that of the brittle condition. These facts, together with a consideration of the manner in which the magnetic properties change on slow cooling, give strong support to the view that temper brittleness is connected with solution and redeposition of carbide. The rise in remanence accompanied by a rise in maximum permeability and a small decrease in coercive force and in hysteresis loss are features which would be expected to characterise deposition from solid solution on slow cooling. The fall in resistivity would similarly be expected. Thus, at the tempering temperature, some carbide is held in solution in ferrite, and is retained on quenching from that temperature, but separates out on slow cooling. The explanation of temper-brittleness, therefore, appears to be, briefly, as follows:—When a steel susceptible to temper-brittleness is cooled slowly from a high tempering temperature, a portion of the carbide, which exists at that temperature in solid solution in the ferrite of the steel, separates out, giving definite modifications of magnetic properties and specific resistance. This also results, at moderate cooling rates, in a contraction and softening, as shown by specific volume and hardness tests. When, however, the rate of cooling is extremely slow, the steel expands and hardens again—relatively to the moderately cooled state—and this is evidently due to the formation of a network of carbide round the grains, producing, by its predominant effect on the coefficient of contraction and its influence in increasing the resistance to penetration, an increase in specific volume and in hardness respectively. Deposition of carbide from solid solution will not, in itself, induce brittleness in the steel. It is only when the rate of cooling is sufficiently slow to allow of expulsion of the carbide to the grain boundaries that brittleness develops.

Dr. W. H. Hatfield said that he did not think the experimental work and results described in the paper could be questioned. The author had added considerably to our knowledge of the physical properties of nickel-chromium alloys in the two conditions. Personally he was inclined only to question the author's theoretical deductions. The author was hardly correct in speaking of the slow-cooled steels as brittle steels; a better term was notch-brittle steels, because if one made an impact test of these slowly cooled nickel-chromium steels and did not put a notch in, the test piece showed no signs of brittleness. It was very tough indeed and there were many uses for such steels. He had not yet seen a carbide which separated out in the manner described by the author. The fact was that the structures of these nickel-chromium steels were so extremely fine that they could not be seen except under the extremely high magnification to which the author had subjected them. If a little molybdenum was introduced into these steels a condition was obtained in which slow cooling did not introduce notch-brittleness. Did the author suggest that the addition of molybdenum prevented the separation of the carbide? The statement was made in the paper that the deposition of carbide from solid solution, in itself, introduced brittleness in the steel, and that it was only when the rate of cooling was sufficiently slow to allow of expulsion of the carbide to the grain boundaries that brittleness developed. As a matter of fact, said Dr. Hatfield, if one were making an aero-crank shaft, which was only a very small forging, the difference between water quenching and cooling in air would, in some types of nickel-chromium steel, lead to an extremely wide variation in the impact value, and he doubted whether the author would suggest that a forging of such a section could be considered as experiencing very slow cooling within the meaning of the sentence in the paper to which he had just referred.

Mr. J. H. Whiteley asked the author to enlarge upon the statement in the paper that it was only when the rate of cooling was sufficiently slow to allow of expulsion of the carbide to the grain boundaries that brittleness developed. He would like him to explain why it was that the carbide should diffuse to the grain boundary and why the nuclei should not grow at the expense of the carbide particles within the crystals.

Mr. Dartrey Lewis said that, roughly speaking, the theory put forward in the paper was that at a temperature of 650 deg. Cent. the ferrite dissolved a certain amount of carbide. If the cooling from 650 deg. Cent. was rapid, then the carbide was carried in solution in the ferrite and a tough material resulted. If the rate of cooling was slow, then the carbide separated out from solution at the grain boundaries and a material was produced which was brittle. That was a very simple explanation of a very difficult problem, and it had been deduced, not from microscopical evidence, but from the physical properties of the steel. That theory was very interesting because the evidence given in Mr. Whiteley's paper which was to follow was based upon microscopic examination and not upon measurements of physical properties. The obvious thing seemed to be that Mr. Dickie should test the material that Mr. Whiteley had been experimenting with to see whether Mr. Whiteley's material showed those same changes in physical properties which Mr. Dickie had found for nickel-chromium steels. If Mr. Whiteley's theory was proved, a very interesting situation arose, namely, that temper-brittleness was not a property of nickel-chromium steels only, but of all steels, including plain carbon steels.

Professor J. H. Andrew asked the author if he had at the back of his mind any suitable theoretical explanation for the extraordinary differences of magnetic properties between the brittle and non-brittle material.

Mr. Dickie, replying to the discussion, said the separation of carbide at the grain boundaries was a very difficult matter to discuss, because no really conclusive microscopic evidence had been put forward so far. At the same time he did not see how it was possible to explain the double effect on specific volume and hardness except by the production of a grain boundary. It was quite probable that the boundary which was produced was ultra-microscopic, and he did not think it would be at all necessary to have a large boundary in order to produce the effects which were produced on specific volume and on hardness. Neither did he think it necessary that all the carbide which was in solid solution at high temperature should separate at the grain boundaries. It might be that if separation took place at a sufficiently high temperature some of the carbide separated at the boundaries and some of it might be deposited on the existing carbide within the grains. He had an idea that that effect might be connected with a temperature difference in solubility; that in a steel susceptible to temper brittleness, not only was solution of carbide in ferrite fairly large at high temperatures, but at temperatures just below those high temperatures—say, from 600 deg. to 550 deg. Cent.—the solubility decreased very rapidly and that fact allowed separation to take place at a relatively high temperature. He had examined a large number of steels to try and find the grain boundary, but except in one case—that of a high-phosphorus nickel steel which could not be considered entirely satisfactory because of the high phosphorus content—he had not observed the grain boundary. It was quite possible that Dr. Hatfield's remark about the addition of molybdenum might mean a difference in the temperature solubility of carbide in alpha iron; it might be that on the addition of molybdenum the solubility range was lowered in temperature and that there was not much difference in solubility of carbide at 550 deg. or 650 deg. Cent. On the other hand, it might be that molybdenum reduced the solubility of carbide in ferrite so much that no appreciable effects were produced. He agreed with Dr. Hatfield in his remark as to notch-brittleness. Replying to Mr. Whiteley, he said that the position appeared to him to be that if the carbide was not expelled to the grain boundaries it must separate out within the grain. It did not appear that we should get much further in this controversy without some other method of investigation, such as X-ray examination. Mr. Whiteley's paper showed that the carbide separated out in two distinct forms, either at the grain boundary or throughout the grains, and that was exactly the conclusion he himself had arrived at by inference from the physical changes taking place, and he regarded the one piece of work as good confirmation of the other. In reply to Professor Andrew, as to the reason for the difference in magnetic properties in the brittle and non-brittle material, Mr. Dickie stated that it could only be assumed that those changes were caused by the deposition of carbide out of solid solution.

Work Hardening and Abrasion.

Mr. E. G. Herbert then read a paper on "The Work Hardening of Steel by Abrasion." We dealt with this paper in a leading article in last week's issue. Mr. Herbert's conclusions are summarised as follows:—

In articles of metal which are subjected to severe abrasion in service a surface layer is produced, the hardness of which is much greater than that of the original metal.

This increase of hardness occurs not only in articles of soft steel, such as railway tires and rails, but also in articles of hardened steel—gears, cams, and the like, whether hardened throughout or case-hardened.

The degree of hardness induced by wear tends to a maximum which varies greatly in different metals, and in different classes of the same metal.

Hardened or case-hardened alloy steels, while differing greatly among themselves in respect of their capacity for superhardening, are generally capable of a higher degree of induced hardness than plain carbon steels of the same original hardness.

The capacity of a metal to resist wear, in so far as it depends on hardness, must depend on the hardness induced by wear, and not on the original hardness.

The maximum hardness which can be induced in any metal by wear corresponds generally with the maximum hardness induced by the pendulum work-hardening test.

The original hardness of a metal gives no indication of the ultimate hardness of the worn surface.

The original hardness of a metal exposed to severe abrasion can have no importance in relation to resistance to wear, since metal possessing that hardness does not exist in the worn surface of contact.

It appears probable that work-hardening or superhardening does not occur unless the conditions of abrasion are so severe as to cause some plastic flow of the metal below the abraded surface. Such plastic flow can occur in very hard steel.

Mr. E. H. Saniter said that whilst the method described by Mr. Herbert was of very great value as a measure of the wearing properties of steel, he would not like to be too dogmatic about it at present, because before the method could be accepted definitely and with confidence it would have to be correlated with wear in practice. It was interesting to note that certain of the metals tested apparently reached a maximum point of hardness, and then there came a breaking down. The breaking-down point was very important with regard to wear, because up to the maximum point the material might be hard and tough and then might become brittle and friable and wear very badly.

Mr. J. H. Whiteley, after expressing regret that the author's results had not been given in the form of curves, said that the figures showed the different rates at which hardness was produced in different steels. Mild steel required only two passes, whilst manganese steel required ten passes, before the maximum hardness was obtained. Did that difference represent any peculiar property of the steel? Did it mean a better steel when a longer time was taken to reach the maximum hardness? Again, after maximum hardness had been obtained there was a slight drop, as mentioned by Mr. Saniter, but the author did not continue the tests beyond that point, and it would be interesting to know whether the drop continued for any length of time. His own view was that a certain amount of energy was expended, part of which was taken up by the steel in hardening, and part by the heat generated; when maximum hardness was obtained, more heat was generated, and there was a slight softening. The rails which the author had tested were old, and before drawing his conclusions he should have examined these steels for segregation and then compared the material with the outside. Some time ago he had examined a rail which had cracked in half after it had been in use for twenty years. It had been in service for a long time on a curve, and the flanges of the wheels had worn one side of the rail for a considerable distance. Microscopic examination showed distinct evidence of abrasion and hardening on the skin. It was thought that the life could be increased by another twenty years if the rail were taken from one side of the curve and put on the other, but when that was done the rail broke within a week. His explanation of the breakage was that the abrasion and hardening had caused slight cracking of the surface. So long as the rail was on the one side, the cracks tended to close up, and thus no fracture occurred, but when the rail was placed on the other side of the curve, and the stresses were in the reverse direction, the cracks developed at once and the rail broke.

Professor C. H. Desch (Sheffield University) said that the pendulum instrument described in the paper was valuable as a research device, but it must not be placed in the hands of an unskilled assistant, because, if the pendulum happened to be a small amount out of adjustment, it took a good half-day to put it right again. On the question of work hardening, he wondered whether the paper referred to work hardening as it was generally understood. Results had been produced by rolling with slight slip or impact, and always by contact with smooth surfaces, but when abrasion occurred in practice there was some cutting edge present, and the abrasion was caused largely by the roughness of surface or actual cutting edges of the abrasive material, such as emery or sand. So little was known about the processes of cutting that we were not yet justified in saying that the resistance to impact or rolling with slight slipping was the same as the resistance to a hard cutting edge. In that connection, one important result of the work of Hultgren in Sweden was the proof that even the hardest steels were capable of considerable superhardening by cold work. With regard to the softening after the initial hardening, had the author observed any slight deterioration of the surface due to a tearing action after the pendulum had been rolling to and fro several times? In a recent paper by Tomlinson before the Royal Society it was shown that, where there was a minute amount of slip, particles of the surface were torn away. These particles were on such a small scale that it was practically molecular removal of the metal, and that metal oxidised on

* No. II. appeared September 30th.

exposure to the air, causing the rust which was familiar to everybody who carried out Wöhler tests. That must occur in Mr. Herbert's work-hardening tests, and he wondered whether the disintegration went so far that the surface was somewhat damaged. That should be visible under the microscope, either as cracks or an accumulation of minute oxide particles, and it might explain the falling off in the hardness. There were several conditions met with in practice which were difficult to explain and which might be explained by that kind of action occurring during the rubbing of one metallic surface over another.

Dr. A. Bramley (Loughborough Technical College) remarked that in the testing of steel balls for ball bearings much the same effect was achieved as that obtained by the author's "Cloudburst" machine. The method of testing was to roll the steel balls over the surface of paper. It was possible to detect, by the imperfection of the reflection of the balls on the paper, which were defective and which were not. The testing took place after the balls had been rotated against each other in containers on an inclined axis, during which process they became polished. Apparently, the impact of the balls against each other flattened those portions of the surfaces which were soft, and the imperfection in the roundness of the balls was shown ultimately by the imperfect reflection in the final test.

Mr. E. G. Herbert, in his reply, agreed with Mr. Saniter that the results of his tests must be correlated with actual practical results before they could be finally accepted. As a matter of fact, he had made considerable efforts to get not only worn tires, but the mileage of those worn tires, but had been quite unable to obtain the information. As to the fact that after the maximum hardness was reached there was a slight decrease, he always carried out the test until the maximum was reached and the slight decrease manifested itself, and then stopped. If the test were continued longer it was found that the decrease, after the maximum hardness had been reached, did not continue very long. What the explanation of the decline in the maximum was, he had no idea whatever. The same decline occurred with manganese steels, and they were well known for their wear-resisting properties, so that if there were any deterioration in quality through the decline it would have shown itself in the manganese steels in the past in practice. He had recently been cutting manganese steel, and after a good deal of trouble he had got a chip, the hardness of which was 700 Brinell, so that the same thing occurred in cutting as under abrasion. The variation of the rate at which hardening took place was decidedly a characteristic of the metal. One metal would harden up to its maximum with only two passes, whilst another might take twenty or twenty-two every time. Whether that difference indicated good or bad properties in practice, he did not know. It certainly, however, differentiated one metal from another. He had made strenuous efforts to measure the heat generated in the work-hardening test by using steels of different composition as the elements of a thermo-couple, and connecting them to an Einthoven galvanometer, but had never been able to detect any rise of temperature. Therefore he felt that the question of the heat generated hardly entered into the process. With regard to the rail mentioned by Mr. Whiteley, he said that it was well recognised that local work hardening was dangerous in any structure, because it tended to localise stresses and introduced cracks leading to breakdown. The process described in the paper, however, was not a local one, but was one producing a hardened layer all over. He did not, however, attempt to speak dogmatically as to what the results would be over a period of years, but he did not believe it would have the effect of producing that local hardening which occurred when a rail had been used under the conditions mentioned by Mr. Whiteley. In reply to Professor Desch, he said he would have to give him half an hour's instruction on how to adjust the pendulum machine, if it really took him half a day to do it at present. It could be done in two minutes. In conclusion, Mr. Herbert said he had used the word "abrasion" because he did not know of a better one for the purpose, but the process was very different from the abrasion that occurred when something was held against an emery wheel. There was no cutting action going on in the process, and from his investigations he had come to the conclusion that superhardening did not take place unless there was plastic flow of the material below the surface. He did not use the word "abrasion" in the paper in the ordinary meaning of the term. He had never seen any evidence of a tearing action with his method, although he had examined many of the samples under the microscope. As to the point mentioned by Dr. Bramley, the test was similar to that which happened in the testing of ball bearings, but it was applied in his case by making a shower of balls strike the surface.

The President, in proposing a vote of thanks to Mr. Herbert, suggested that the paper would be improved if a sketch of the Cloudburst machine as it was intended ultimately to make it were embodied in it.

Solution and Precipitation of Cementite.

The final paper was by Mr. J. H. Whiteley on "The Solution of Cementite in α-Iron and its Precipitation." The following is the author's summary:—

It is shown that carbon is soluble in α iron at temperatures above 630 deg. Cent. It can be retained in solid solution by quenching; on tempering, precipitation occurs in the ferrite grains at or below 250 deg. Cent., and as the temperature rises the minute particles thus formed travel to the grain boundaries. The speed of this movement is very great at 550 deg. Cent. Above 630 deg. Cent. the solubility gradually increases with the temperature. At 720 deg. Cent. it is about 0·03 per cent. As the purity of the ferrite is diminished the initial temperature for solution rises a little, and at the same time the solubility is, in all probability, correspondingly reduced. The rate of diffusion of the dissolved carbide at the A_1 point is extraordinarily rapid. During slow cooling the dissolved carbide is deposited on existing crystals. The inference to be drawn from the observations is that slowly cooled ferrite in ordinary steels contains very little, if any, carbon in solid solution. The presence of dissolved carbon in a iron increases its Brinell hardness to a small but definite extent.

Dr. W. H. Hatfield said that the very troublesome point as to whether α-iron contained iron in solution must be settled. It would appear from the paper that at the separation of ferrite from the solid solution the ferrite contained carbide, but that at the lower temperatures the carbide was thrown out of solution. Previously, however, the view had been strongly held that the ferrite might, and probably did, contain as much as 0·05 per cent. of carbon, but it seemed very doubtful, as the result of the author's work, whether that was true. It would be very valuable to follow up the author's work by carrying out physical tests on the material in its different conditions, and he believed it would probably be found that, within the range of temperature mentioned in the paper, the mechanical characteristics of the material were affected. These two aspects of the matter needed to be correlated.

Professor J. H. Andrew said that the curious point about the work described in the paper was that the author first heated his steel up to about 680 deg. and quenched it and obtained all his carbon in solution; then he heated it up a second time and gradually got the carbon out of solution. Had the author tried the effect of carrying the first heating—which he understood was maintained at a temperature of 680 deg. for one hour—for so long a period as one day? The paper referred to carbide diffusing through the steel, and from the author's statement it might almost be taken that he assumed the carbide to diffuse, so to speak, in small lumps. Before, however, the carbide could diffuse through the interior of the grain to the boundary it must first go into solution. In such a case there were one or two peculiar physical properties to contend with. The moment nuclei of carbide were deposited there was a tendency to get deposition, or even solution, of these nuclei, and one also had to deal with residual valencies at the grain boundaries. He had noticed that phenomenon in boiler plates and ship plates which had been found to be brittle, and had observed that in every case brittleness was due to a continuous film of deposited carbide, but wherever there was a break in the film the brittleness disappeared. It was impossible to draw a direct analogy between Mr. Whiteley's work and that described by Mr. Dickie in his paper, because account had to be taken of the fact that in special steels a good deal of the peculiar change was due to a widening of the Ac range, so that the cases of carbon steel and special steel were not truly analogous.

Professor C. H. Desch said that there was some difficulty in imagining how the migration to the boundary, which had been spoken of, took place, and he agreed with Professor Andrew that it could not occur without previous solution. He could not understand particles of appreciable size migrating bodily through the space lattice. It was possible that when the whole of the carbide was in solution the state of equilibrium would not be one of homogeneous distribution, but that there would be a greater concentration at the grain boundaries. That would be the case if the effect of carbon was to lower the surface tension of the metal. At present we did not know the surface tension of solid α-iron, but if the surface tension could be determined, and if it were found that the presence of carbon in solution lowered that surface tension, then it followed theoretically that the equilibrium concentration of carbon must be greater at the grain boundaries than in the interior. On cooling, the concentrated solution of carbide at the surface would be supersaturated, and would reach a state of supersaturation much sooner than the interior of the grain would do, so that there would be deposition occurring at the grain boundary. That, perhaps, supplied a possible reason for the migration to the grain boundary, but the supposition was very difficult to test. At Sheffield University they were trying to investigate the question at present with certain non-ferrous alloys which seemed to be much easier to experiment upon than steels, but it was very difficult to get experimental proof of the migration.

Dr. D. Hanson remarked that the facts brought out by the author with regard to solubility seemed to be very similar to what occurred in a number of non-ferrous alloys, notably some of the aluminium-copper alloys, in which compounds were known to have considerable solubility at high temperature and a much lower solubility at a lower temperature. He suggested to the author that if he could carry out a few simple tests and establish the age-hardening property of ferrite containing a little carbon he would get further information on the difference in solubility of the carbide, and he might also find considerably greater hardening effects than were shown by the plain quenching test he had used in the work described. It might be found that age-hardening gave quite a considerably greater difference in hardness than the experiments in the paper showed, and it was quite possible that some of the ageing effects which were known to occur in certain steels well below the critical range might be at least in part accounted for by the observations put forward in the paper.

Mr. H. A. Dickie said that Mr. Whiteley had demonstrated very conclusively that carbide might separate out of solid solution in ferrite in two distinct forms, either in a fine state of division throughout the mass—by means of separation at a relatively low temperature—or at the grain boundaries by means of separation at a relatively high temperature. That was exactly the conclusion which had been drawn from his (Mr. Dickie's) own work on the physical changes concerned in the temper brittleness of special steels. He thought the only difference between those two cases in the pure materials dealt with by Mr. Whiteley and the complex materials he himself had used was that the separation in either of the two forms took place with greater rapidity when the ferrite was pure than when special elements were present, and that in the case of special steels it seemed evident that the carbide boundary which was produced by separation at high temperature was more stable and less easily destroyed. In the materials used by the author the only element which varied much was the manganese. The author found that the increase in manganese raised the temperature range of solubility, and he also thought that that meant that when manganese was added to ferrite the solubility was less. Personally he did not think the latter conclusion could be correct, because it was well known that 2 per cent. manganese steel was highly susceptible to temper brittleness, and he could not think that such marked susceptibility to brittleness could be obtained without a considerable solubility of the carbide in the ferrite at a high temperature.

Mr. E. A. Atkins said that for some years he had been investigating the formation of carbide at the grain boundaries, and in a paper which he had read at the May meeting of the Institute, in London, he had shown that the mechanism of the formation of carbide at the grain boundary was similar to that which the author had so excellently worked out. He was also concerned with the practical implications of the formation of carbide at the grain boundary, having for a number of years had to deal with the manufacture of wire, sheets, and thin plates, in which the formation of carbide at the grain boundaries had always been a source of great trouble. He had examined mild steel wire used in the manufacture of wire netting. When annealed, it was quite soft, but when made into netting and rolled into bundles it was common to find the wire broken in hundreds of places in a 50-yards roll. A careful examination had shown that the occurrence was entirely due to the precipitation of carbide at the crystal boundaries. In connection with sheets and thin plates it was necessary to adopt special methods of annealing to prevent fracture right across the sheets or plates in the straightening machine. In every case of that type which had been investigated he had found the ferrite crystals entirely surrounded with carbide, and his investigations had led him in the direction of finding ways and means by which to anneal steel which had a tendency to keep the carbide in solution, and he had succeeded in doing so. On the question of the amount of carbide or carbon which the author had found in solution in the crystals, Mr. Atkin said he had many times examined very low carbon steels under the microscope, containing 0·03 or 0·04 per cent. of carbon, and had failed to find any pearlite present; yet when they had been annealed and examined again, cementite had been found at the grain boundary, showing that what the author had stated, namely, that the carbide had been in solution and, after cooling, at certain temperatures it had been thrown out of solution, was correct.

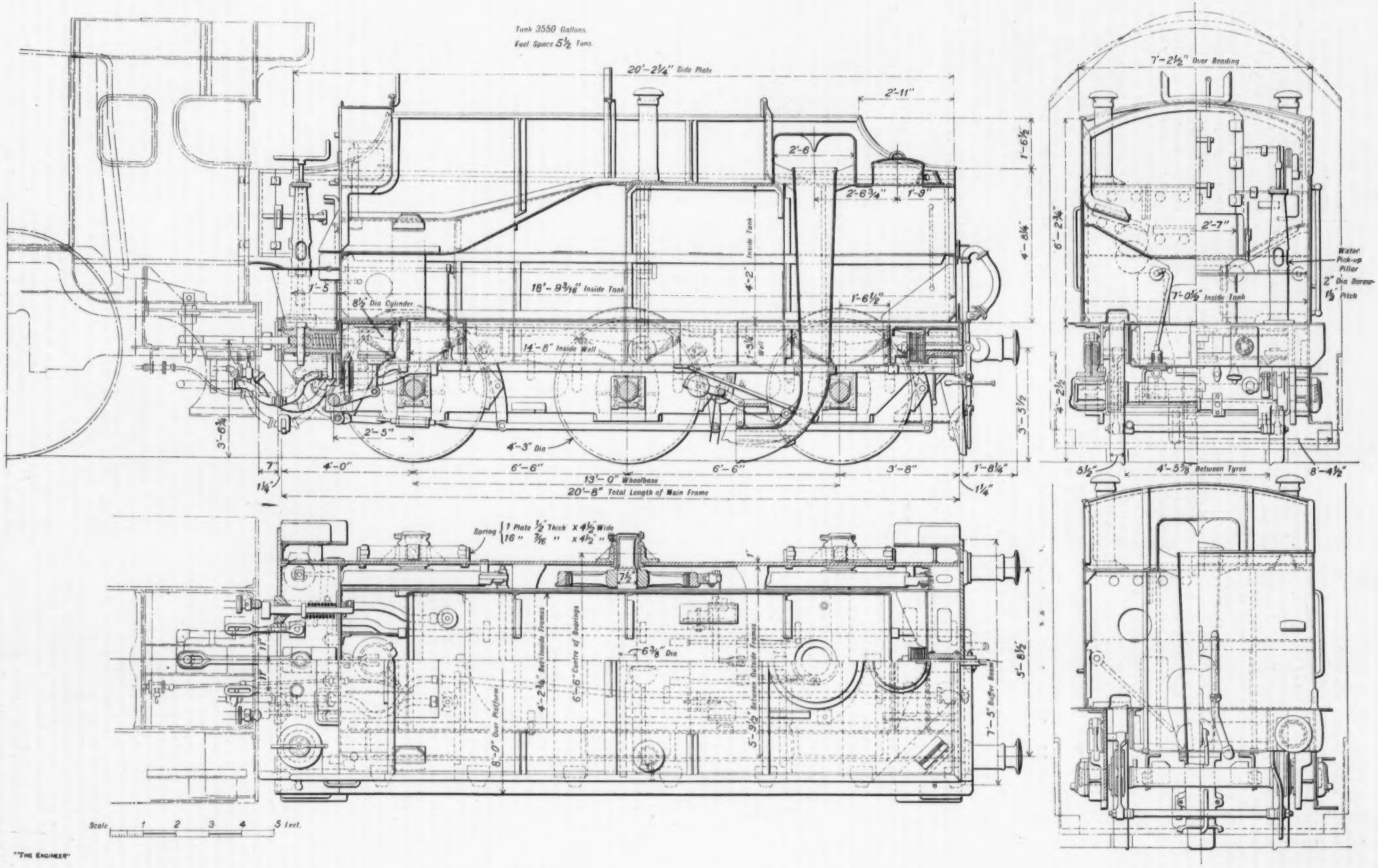
Mr. M. L. Becker asked whether it was possible that small particles of carbide might migrate owing to the solubility of α-iron itself, because, he said, he had noticed some evidence that carbide of iron took iron into solution, at any rate at the higher temperatures. In very large masses of cementite which had been cooled there had appeared bands of pearlite, and when quenched at, say, 1000 deg. Cent. those bands had been very much smaller, although he could not say that they had been entirely absent.

Mr. Whiteley, in his reply to the discussion, said that he had not made the additional tests suggested by Dr. Hatfield, and he thought that work should be taken up by some of the younger members, as he himself was too busy. The discussion could be summed by saying that some people favoured the solution theory, whilst he favoured the bodily movement of carbide particles, and that was a dilemma out of which he saw no way at present. His difficulty with the solution theory was that if the carbide particles dissolved and the carbide migrated to the boundary and was re-deposited there, it must take time, because the gradients were so extremely small, and yet the whole process took place in about one-tenth of a second. That was the difficulty which had forced him to the alternative of the bodily movement of the particle. Mr. Becker had mentioned that it might be possible for that to take place owing to the solubility of iron in carbide, and he himself thought that was possible, but the carbide particles, where not too large, did, in his opinion, actually move bodily to

L. M. AND S. RAILWAY—TENDER OF 3-CYLINDER EXPRESS LOCOMOTIVE "ROYAL SCOT"

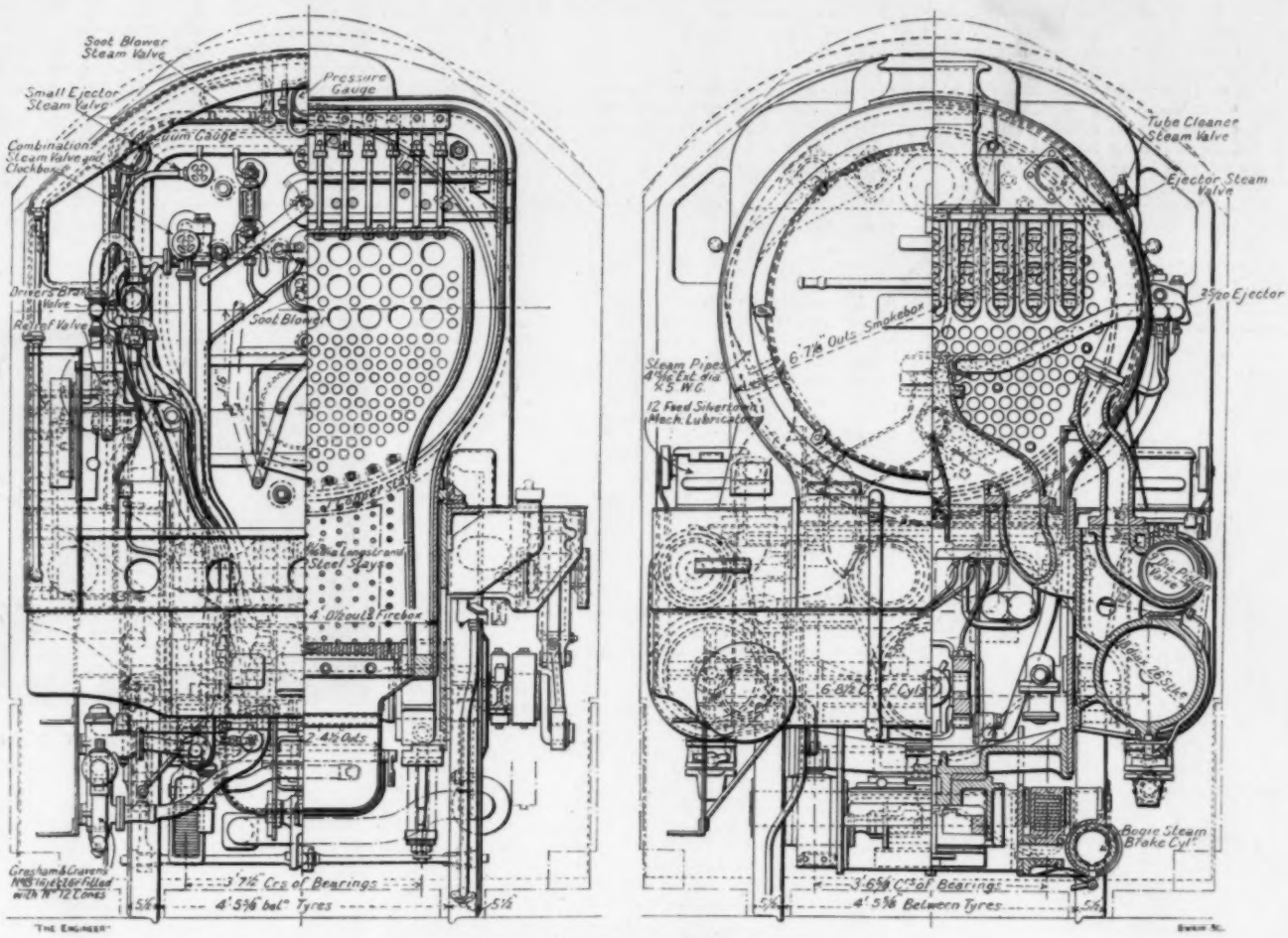
BUILT TO THE DESIGNS OF SIR HENRY FOWLER, K.B.E., BY THE NORTH BRITISH LOCOMOTIVE COMPANY, LTD., GLASGOW

(For description see opposite page)



"THE ENGINEER"

L. M. AND S. RAILWAY—3-CYLINDER EXPRESS LOCOMOTIVE "ROYAL SCOT"



HALF ELEVATIONS AND CROSS SECTIONS

the bounadry of the grain. Until evidence to the contrary was brought forward he intended to hold to that view. Residual valencies, mentioned by Professor Andrew, might have some effect, but only over very small distances; it would not influence the carbide right inside the big grain, and that was his objection to that theory. As to Professor Andrew's remarks concerning boiler plates which failed with a continuous film of carbide at the boundary, he personally had examined hundreds of specimens of boiler plates and had never yet seen carbide in films at the grain boundaries. The question of age-hardening, mentioned by Dr. Hanson, was an interesting one, but that again must be left to some student to investigate.

The meeting closed with a cordial vote of thanks to all those concerned with the arrangements for the meeting in Glasgow.

L. M. and S. Railway Locomotive "Royal Scot."

THROUGH the courtesy of Sir Henry Fowler we are able to give this week drawings of a locomotive which has attracted, since it was put upon the road, no little public interest. We believe it is no secret that it was especially designed to remove the necessity of double-heading on expresses to the North, and its success was shown when it took a heavy train from London to Carlisle without a stop, as recorded in our Seven-day Journal last week. But apart from its power, it has attracted attention by the fact that in its design Sir Henry departed from the compounds with which the name of the L.M. and S. Railway is associated, and adopted the three-cylinder simple principle. They work with a pressure which but a short time ago would have been considered abnormally high, particularly for a simple engine, namely, 250 lb. per square inch, and with 85 per cent. of that pressure they develop a tractive effort of 33,150 lb. The fire-box is rather long, 10ft. 3in., and in consequence a drop grate, operated by a hand lever from the cab, has been provided. The braking is ample, as steam and hand-operated blocks are applied to the bogie, and to all the wheels on the tender as well as to the coupled wheels. An interesting little point is that, owing to the height, a special form of pop safety valve had to be designed, and the steam whistle has had to be upon its side instead of upright.

Fifty of these engines are being built by the North British Locomotive Company, Ltd., and we believe they are the first three-cylinder engines to have three independent sets of Walschaerts valve gear.

The tender follows the company's standard design. It carries 3500 gallons of water, and is fitted with a water pick-up. A folding door in the tender front, which enables the fireman to get into the bunker with ease, is a new feature. We give a drawing of this tender on page 390.

A table of the principal dimensions and particulars is attached. We may remind our readers that a picture of the engine and a weight diagram appeared in our issue of August 5th last.

Leading Particulars of L.M.S. Engine No. 6100 (*Royal Scot*), 4–6–0 *Express Passenger.*

Heating surface—	
Tubes: 180 small, 2in. ext. dia.	1366·5 sq. ft.
27 large, 5⅛in. ext. dia.	525·5 ,,
	1892·0 ,,
Fire-box	189·0 ,,
Total	2081·0 ,,
Superheater	445·0 ,,
Grate area	31·2 ,,
Boiler pressure	250 lb./sq. in.
Cylinders—	
Number	Three
Diameter	18in.
Stroke	26in.
Diameter of wheels—	
Bogie	3ft. 3½in.
Coupled	6ft. 9in.
Dia. of boiler barrel (outs. at throat plate)	5ft. 9in.
Length of boiler barrel	14ft. 0⅛in.
Length between tube plates	14ft. 6in.
Length outside fire-box at foundation ring	10ft. 3in.
Wheel base of engine—	
Bogie	6ft. 6in.
Coupled	15ft. 4in.
Total wheel base of engine	27ft. 6in.
Wheel base of tender	13ft.
Total wheel base of engine and tender	52ft. 9½in.
Total length over buffers	63ft. 2½in.
Tractive effort at 85 per cent. of boiler pressure	33,150 lb.
Weight in working order—	t. c. q.
Engine	84 18 0
Tender	42 14 0
Total	127 12 0

IN his report on the disaster at the Bilsthorpe Pit, on March 1st, when fourteen men were killed by the collapse of a rising main, Mr. H. Walker, Chief Inspector of Mines, says that in the system followed at Bilsthorpe and elsewhere the pipes forming the rising main column are supported merely by standing one upon another, the clamps serving only to keep the column vertical. The failure of one pipe involves the collapse of the whole of the range above it. To obviate this further support is necessary, and in future it should be of such a character as to ensure that each pipe is separately and distinctly supported. There are several ways in which that can be done, and the Inspector is quite certain that those in charge of sinkings will have no difficulty in finding that method which is best suited to their needs. The provision of flexible suction pipes would also appear to be desirable.

The British Steel Industry.*

By R. D. MOORE, B.Sc.

THE subject of my presidential address is Steel, and I have the satisfaction of knowing that it is one which appeals in no small degree to members of this Institution, as the material predominates so largely in the work of the shipbuilder and engineer. Indeed, it might even be said that steel occupies first place in the prosperity of an industrial nation. Britain realises this now, when she has ceased to be the unchallenged chief steel producer for the world. Fifty years ago she supplied the ships, engines and engineering material for almost the whole of the world, without serious competition, because she was favoured among nations in having within her borders the only convenient ores from which pig iron suitable for making good steel could then be produced.

America was the first serious rival, and, developing her vast resources of material, soon outstripped this country in output, though it is only within comparatively recent times that she has been able to put her steel upon European markets. Germany, requiring to import high-grade pig iron, lagged far behind, until in 1877 two Welsh chemists, Sydney Thomas and Percy Gilchrist, discovered and introduced the basic process of steel making. This put Germany in the position, by employing her Lorraine ores, which were pre-eminently suitable for the basic process, of turning out cheaply the best qualities of mild steel.

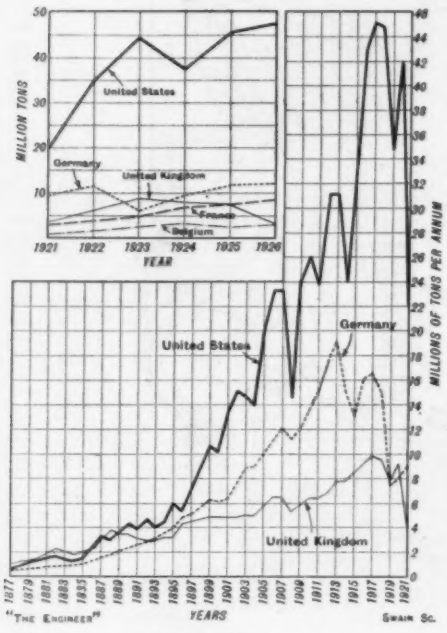
The basic process was first worked on a commercial scale at Middlesbrough in 1879, and Germany forthwith adopted it. Fig. 1 shows the steel outputs of Britain, America and Germany commencing at 1877, which marks the beginning of the struggle of these nations for first place in output, till 1921, the slump period after the war. It will be seen from this figure that the United States and Britain first coincided in output at 1879, and it was 1893 before Germany outstripped Britain in output. But these two countries, excepting Germany during 1919 to 1921, continued to keep well ahead. The largest outputs of the three countries are:—United States, 47,134,000 tons (1926); United Kingdom, 9,553,715 tons (1917); Germany, 18,935,089 tons (1913).

In 1926 the world's steel-making capacity was estimated roughly to be 116,000,000 tons. Of this, one-half has to be credited to the United States, which

* Presidential address, Institution of Engineers and Shipbuilders in Scotland, October 4th. Abridged.

could produce four times as much as Britain and three times as much as Germany. Fig. 2 shows the yearly output of steel from 1921 to 1926. The figures of this period may be taken as indicating the capacity of recovery of the nations after the slump resulting from the war. I have included France, as, having regained possession of the Lorraine ore deposits under the Treaty of Versailles, she bids fair to outrival the United Kingdom in third place, with an output of 8¾ million tons in 1926; and Belgium, as, with the special advantages under the reparation arrangements, she has been able to bring her plant up to date and is rapidly increasing her output.

The imports of iron, including pig iron, and steel into the United Kingdom from Germany, Belgium, France and the United States show an all-round increase from 1923, except from the United States. Compared with 1913, the noticeable feature is the decline from Germany and the increase from Belgium. Indeed, in 1926 Belgium appears to have supplied



FIGS. 1 AND 2

over 50 per cent. of the total. Possibly, however, this figure includes French and German material shipped at Antwerp, and not specially entered. A steadily increasing figure is shown from France. The United States, being concerned in an increasing demand for her internal use, has little to spare for export.

Between the years 1920 and 1925 there has been an increasing proportionate export of iron and steel to British Possessions, as is shown in the following table:

	Total foreign countries.	Total British possessions.	Unallocated.	Grand total.	Value, £
1913 ..	2,596,826	2,372,399	—	4,969,225	55,350,747
1920 ..	1,840,899	1,410,326	—	3,251,225	128,907,361
1923 ..	2,360,484	1,957,053	—	4,317,537	76,155,978
1924 ..	1,923,494	1,927,941	—	3,851,435	74,534,120
1925 ..	1,491,510	1,694,791	544,722	3,731,023	68,162,243

Special Steels.

At the present time special calls are being made upon the metallurgist to produce a suitable material to meet the conditions of high-pressure and superheated steam. During the Summer Meeting many had the opportunity of studying the boilers of the King George V., which is the latest outcome of the realisation that further economy in the use of steam lies along the lines of still greater pressures and temperatures. The pressure of 575 lb. per square inch at the boilers, with a temperature of 750 deg. Fah. in the King George V., have been greatly exceeded in land installations. At the Edgar station of the Edison Electric Illuminating Company, Boston, U.S.A., boilers have been working at a steam pressure of 1200 lb. for about two years. The boilers were forged by the Midvale Steel Company from 78in. ingots, trepanned and pressed. The design has just been laid down for the first extension at that station, which will consist of two 1500 H.P. boilers for a working pressure up to 1500 lb., with 1400 lb. as the normal operating pressure. Up to this point, steel has satisfactorily withstood the conditions imposed upon it, but it is questionable if it can be relied upon to do so much higher up the scale of temperature and pressure.

The results obtained by Mr. J. W. S. Dickenson, of Vickers Ltd., are very interesting. He found that a nickel-chromium alloy of 70 per cent. nickel, 15·5 per cent. chromium, and 0·54 per cent. carbon, stood better than any steel. The test conditions were carried on uninterruptedly over a prolonged period, even up to three years, and this makes the results specially useful. Professor Lea, of Sheffield University, has also found that above certain temperatures creep is continuous. At higher loads therefore failure would take place if the duration of test were sufficiently prolonged.

The general inference to be drawn from the results of such tests is that nickel steels stand better than plain carbon steels; high chromium steels also stand high temperatures well, but those alloy steels containing a high percentage of both nickel and chromium stand best of all. Steels, however, are surpassed by nichrome alloys, in respect of their capacity to stand high temperatures, but nichrome alloys have the disadvantage that they do not forge well. In the light of these figures, it seems advisable to proceed with caution in dealing with further developments in high-pressure boilers.

Steel Castings.

In the course of further remarks, I propose to refer briefly to the special branch of steel manufacture, namely, steel castings, in which I have been engaged for over thirty-five years. The beginning of steel foundry work is rather obscure, but credit for melting blister steel bars in a crucible and casting into moulds is given to Huntsman, a Sheffield watchmaker, in 1740, and up to a little over fifty years ago this was still the method of making cast steel. Germany made striking advances in this industry, and at the Exhibition in London, in 1851, a crucible ingot weighing about 2½ tons, the largest that had up to that time been produced, was shown by Krupp, of Essen. In the following Exhibition of 1873, the same firm exhibited another ingot of 51 tons in weight. This feat was accomplished by men trained to work together with military precision, carrying crucible pots containing about ¼ cwt. of melted metal, which were poured in rapid succession into the ingot mould. From the steel in ingots such as these, the early Krupp guns were forged. Krupp's record for crucible steel castings commences in January, 1812, and the material possessed excellent wearing qualities. Over thirty years ago I was shown a crucible steel pinion at Summerlee, Mossend, supplied by Krupp, which had been in use for a long period, and showed little signs of wear. Krupp's installed the Siemens process at their works in 1869. In this country, Sheffield claims to have a firm still operating which made crucible steel castings nearly 100 years ago. The difficulties in making large crucible steel castings gave a limited scope to this industry, and it was not till the products of the Bessemer and Siemens processes came into use, about 1870, for large castings that rapid development took place.

The first British warship to be fitted with steel castings was H.M.S. Forth, completed in July, 1889, which vessel had a steel stern and stern-post. The use of steel in the Navy has steadily developed until, in a modern large cruiser, the total weight of steel castings amounts to over 700 tons, distributed between hull and machinery in the ratio of 450 tons to 260 tons. The date when a specification for steel castings first appeared under Lloyd's rules was 1889–90, in the section appertaining to keel, stem, and stern-posts.

The production of crucible steel, being largely a question of the addition of the proper proportions of pig iron and scrap, melted under conditions which eliminate oxidation, offered no special difficulty in the making of sound castings. It was, however, vastly different in the case of steel castings made by the Siemens or open-hearth process, where oxidising conditions were the essence of the process. It was found that the steel suitable for rolled material, requiring only the addition of manganese (Mushet's discovery), gave porous metal when used for castings. This trouble, caused by occluded gases and dissolved oxides, was overcome by the steel founder after much bitter experience, by the addition of silicon or aluminium along with the manganese.

I now refer to a few typical examples, and comment on some of the difficulties incidental to their manufacture. An ingot is really the simplest form of steel casting, and in cooling from the molten to the solid state passes through various stages. The effect of this is to cause the inside wall of set metal to contract towards the outside, and draw away from the melted metal in the interior, thus forming a cavity. Into this cavity the melted metal of the interior sinks, and continues to do so as long as a drop of molten metal remains. In a 10-cwt. ingot, 36in. long by 9in. square at the top and 12in. square at the bottom, cast in an iron mould, the cavity extended downward 17in. and measured 5in. by 4in. at the top. That is to say, that 4 cwt. of the ingot as cast were unsound, and 6 cwt. consisted of solid metal. It will be understood that, in casting, a feeding head of sufficient size to contain all the piping has to be provided, and this must not be less than one-third of the casting, and not of less section than the part which it feeds. The removal of large feeding heads, especially on parts inaccessible to cold cutting saws, gave rise to some difficulty until oxy-acetylene cutting plant

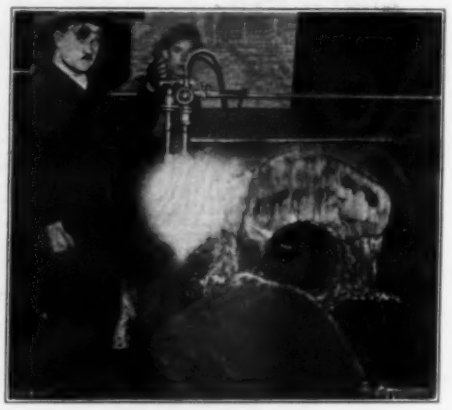


FIG. 3—CUTTING OFF FEEDING HEADS

was adopted. The propeller boss—illustrated in Fig. 3—had two heads, each 3ft. 9in. long, and 18in. at the thickest part. The time taken to remove each of these was 20 minutes, with a consumption of 324 cubic feet of oxygen, and the cost of this, with the small quantity of acetylene used, was 10s. An operation of this kind recently undertaken was the cutting of the breech of a 15in. gun. The metal in this case was 24in. thick, and the length 5ft. I learn that 27in. thickness of steel has been successfully cut by the oxy-acetylene process. In castings generally about ¼in. of excess metal has to be left, and an objection to the oxy-acetylene process is that the part in contact with the flame is burnt and becomes hard. This calls for removal by the electro-welder.

The contraction of steel from the molten stage to cold metal is about $^1/_8$in. per foot. From experiments I made, I found that practically half the total contraction takes place during the cooling of the metal from the hottest fluid condition till just at the point of setting, while it is still plastic; the rest of the shrinkage from this point until cold takes place in solid metal. The heat-resisting composition used in the mould hardens almost like concrete after drying, and this makes the question of shrinkage a very difficult one for the steel founder. To illustrate this, I show, in Fig. 4, a small stern tube, 14ft. long by 11¼in. outside, and 9¼in. inside diameter. In this case there was a difference in length between the cast and the finished lengths of nearly 3in. The main thickness of the tube being 1in., the metal set almost immediately. The tube was cast on end to permit of free shrinkage as far as possible, and the core made soft to yield to the contraction towards the centre. There are two belts of thicker metal on the casting, and the method of bracketing to prevent the quicker contracting thin metal drawing apart from the still liquid, or plastic, metal is shown. These ribs, which are of a section to correspond to the thinner metal,

FIG. 4—STERN TUBE CASTING SHOWING BRACKETING

set quickly, and prevent fracture of the parts they protect. It is to be observed, however, that, owing to the unequal times of contracting, the casting when cold is in a state of great tension, and the ribs must be kept on till after the casting has been annealed. It is of the utmost importance, in dealing with castings liable to fracture during the process of cooling, that the materials from which the steel employed is made be free from excessive impurity. Sulphur is especially hurtful, because its effect begins when the metal is hot and in a condition of little strength.

Thirty years ago steel propellers and propeller blades were much in demand, but a serious objection to their use was their short life, owing to pitting caused by cavitation. The advent of bronze propellers offered many advantages, and lessened the demand for steel blades, except in cases where special strength was required, such as working in ice; 3 per cent. nickel steel forms an excellent material for this purpose, and has the added advantage of resisting pitting to a large extent. Solid steel propellers are nearly always moulded by sweeping, and this calls for care. Only one head can be put on the casting, and this on the boss, so it requires to be both large and high. The danger points are at the junction of the boss and blades, and cracking there can only be prevented by bracketing. Fig. 5 illustrates a vane casting made for Wm. Denny and Brothers, Ltd., which has a diameter of 8ft. 2in. The conditions in casting are similar to those of a steel propeller.

Geared wheels and wheel blanks offer some difficulties in casting. The first risk with such castings, especially when large in diameter, is distortion in cooling, which results in the wheel becoming oval. A special danger point in blanks is in the rim at the junction of the arm, the lighter section of these tearing away from the heavier still fluid metal of the rim. A method of counteracting this which is quite successful consists in placing cast iron chills in the moulds opposite these places. The chills are of sufficient thickness to cause the metal in the part of the rim to cool uniformly with the arms. A large wheel or rim cast in halves introduces another difficulty. In cooling, the ends draw out, due to the strains along the greater outside diameter after the metal has set. In a 10ft. diameter ring cast in halves, an increase of 2in. in the diameter may be caused in this way. This may be overcome by moulding out of truth to this extent.

FIG. 5—VANE WHEEL CASTING

Castings in connection with Belleville boilers were about the first to tax the ingenuity of the steel founder, but by the time this type of boiler went out of favour, such advances had been made that reliable castings were readily produced. Valves and pipe connections, required in large quantities by the British Admiralty, at first gave some trouble in producing sound castings, owing generally to faulty design, from the steel founder's point of view. The trouble with the first valves lay in uneven thicknesses of metal, but with this difficulty removed the making of sound valves came to be a matter of careful moulding and the employment of suitable metal.

A difficulty arises in connection with intricate castings of light section, such as valves, in providing test pieces. All surveys call for test pieces to be cast as an integral part of the casting This can only be done by casting the bars at the side, with a connecting attachment, so that not only is the casting endangered, but the metal comes to the test piece through the casting, and so is chilled and runs sluggishly. Consequently, good results are not obtained in this way, and the test piece is not representative of the casting. Under these circumstances, I think a departure from the present method of testing light castings might be made in favour of separate furnace charge test pieces. These could even be tested unannealed.

Comparative results of a 16 per cent. carbon steel show:—

	As cast.	Annealed.
Maximum stress per tons square inch	29·18	29·17
Yield point	17·66	18·44
Elongation on 2in., per cent.	23	31
Reduction of area, per cent.	29·5	46·1

If satisfactory results were obtained, the castings could then be annealed in an approved oven, using a recording pyrometer. The heat diagram would be submitted to the surveyor as a preliminary to making the final examination of the castings.

The Future of the Steel Industry.

Any paper dealing at the present time with statistics of a basic industry such as steel would not be complete without some pronouncement on Britain's ability to counteract the fierce competition of continental firms. In 1924 Germany, having stabilised her financial position, set herself the task of organising her internal and external trade. As regards steel, this was relegated to an association called the "Rohstahlgemeinshaft," the primary object of this organisation being to regulate production in relation to the existing demand, and to fix prices. To make this effective, it was necessary to embrace not only Germany, but all the steel-producing countries of Europe. After many conferences, an agreement was drawn up and signed in September, 1926, by Germany, France, Belgium, and Luxemburg, the allocations of production being in the first instance:—Germany, 40·45 per cent.; France, 31·89 per cent.; Belgium, 12·57 per cent.; Luxemburg, 8·55 per cent.; Saar (Germany two-thirds, France one-third), 6·54 per cent.; total 100·00 per cent.

In December, 1926, further conventions brought Austria, Hungary, and Czecho-Slovakia into the agreement, the whole organisation being controlled by Germany. Britain, the only remaining great European steel-producing country, stood aside in an attitude of friendly neutrality, preferring to encourage and develop her external trade with her Colonies and Possessions, of which India was her best customer, taking in 1925, 480,801 tons of steel. But the advantage of the continental combine of the German organisation soon became apparent, especially in the case of exported material, to which special preferences were given. The general effect was that Britain found herself quite unable to submit economic prices to the world's markets in competition with continental makers. A comparison is given of the position at the present time:—

	British. Home price, delivered locally.	British. Export, f.o.b. Glasgow.	Continental. Export, f.o.b.
	£ s. d.	£ s. d.	£ s. d.
Steel ship plates	8 2 6	7 12 6	7 0 0
,, sections	7 12 6	7 2 6	4 10 0
,, bars	8 12 6	8 2 6	4 13 6
,, Billets	—	—	4 5 0
,, sheet bars	—	—	4 7 6

The disparity between prices of section bars, billets and sheet bars is overwhelming, and the outstanding feature is that while in the last few years the large British companies working on steel alone have lost money, the German steel companies have declared huge profits. Undoubtedly, the continental combine is making a strong effort to capture British markets and kill her steel industry as a whole. Suggested remedies are all on the basis of reorganisation—this to take the form of amalgamation in groups; closing down of inefficient works, leaving the best equipped to work at their full capacity. Some alleviation of burdens is also called for; local rates and taxes under existing valuation scales press especially hard and call for remedy.

Transport charges are far too heavy, but as the railways do not pay, further consideration of this point leads to politics, it only remains to state that in comparison with continental transport charges Britain is enormously handicapped. British railway rates on coal average 3s. 8d. per ton, being 83 per cent. in excess of the 1913 figure of 2s. per ton, while German rates have only increased by 41 per cent. A comparison of the present transport charges on coal with those in force before the war shows that in South Wales the percentage increase is 87—from 1s. 8½d. to 3s. 2½d. The percentage increase on the Forth is 75, and on the Clyde 71. Taking account of the tonnage shipped at the various ports, the average transport charge in 1913 was 1s. 11½d., and in 1927 3s. 5½d. In contrast to this, it should be noted that the index number of wholesale prices is only about 40 per cent. above the pre-war level. Further, the railway rate for export coal from a Scottish colliery to Glasgow, a distance of 35 miles, is 3s. 7d. per ton, and to Bo'ness, a distance of 18 miles, 2s. 6d. per ton; while from a Polish colliery to Danzig, a distance of 375 miles, the rate is 4s. per ton.

On September 1st last a British steel combine offered rebates off steel prices ranging from 5s. to 7s. 6d. per ton to users who undertook to employ only British steel. This is a distinct advantage to the consumer, and it is to be hoped that the larger outputs which it is anticipated will result from this scheme will go some way in the direction of cheapening the cost of production. How Britain will fare in this industrial struggle of competing nations, it is difficult to forecast. No doubt Britain has many advantages. It is an island, no part of which is far from the coast, where there are good harbours. There are coal, iron ore and limestone in close proximity to one another, so that the making of iron and steel should be cheap; and the works are close to the harbours, so the cost of carriage of both the raw and finished material should be light. In Germany and the United States the raw materials have to be assembled from great distances, and when manufactured they are far away from the harbours from which they have to be shipped. No doubt the rate of carriage of the goods per ton per mile is much cheaper in America and on the Continent than in Britain, but when transport distances are taken into account, the total sum to be paid for carriage is less in Britain than it is abroad. Then, though we all revile our climate, I doubt if there is any other place where work can be carried on outside for more days in the year than in Great Britain. We have an industrious body of skilled workmen as good, if not better than any others in the world, and our leading works are well organised and up to date. The great trouble with industry in this country is the political interference, and misguided labour leaders who hamper the workmen. After all, there is no more common sense man in the world than the British workman, and I have no doubt he will in time see that it is in his interest to do his best and help industry. Even politicians may yet recognise that for the benefit of the country it is better to leave industry alone to work out its own salvation. With a better understanding between employers and employees, I have no fear for the future of our heavy industries. It is only some thirty years since trade unionism began to give trouble in British industry, and, after all, thirty years is but a short time in the life of a nation. We have come through the greatest war in history, and last year we passed through the longest strike on record. After such occurrences there is bound to be great disorganisation, from which it takes time to recover; but of our ultimate success I have no doubt.

SIXTY YEARS AGO.

The application of science and of scientific method to the art of conducting war was, sixty years ago, proceeding at a pace which to those then living seemed tremendous. What was the future warship to be like? we asked in our issue of October 4th, 1867, and the answer given was "a floating fortress manned by soldiers and officered by mathematicians." The only reason given for the aphorism was the fact that the men and boys of H.M.S. Excellent were receiving instruction not only in sea gunnery, but in field gunnery and musketry, and were being drilled exactly like soldiers. Their officers' qualifications as mathematicians apparently began and ended with a strict examination in the "Manual of Field Service," or "soldier's red book." At that date the Abyssinian War was about to begin, and to assist the expedition, the Government was adopting, or was being urged to adopt, all the latest aids to efficiency. One suggestion recorded in the issue quoted came from Mr. William Coningham, of Brighton. It contained nothing more startling than a proposal to lay down a railway from Massowah to Debra Tabor. The construction of such a railway, it was urged, would be a far better plan than the purchase of "mules and jackasses" for the transport of troops and implements of war. Mr. Coningham believed that the undertaking would be found perfectly practicable, that it would save the lives of thousands of men, that it might help to civilise as well as terrify the Abyssinians, and that it might actually be made to pay. The scheme was certainly not more unreasonable than that indicated in an announcement in the same issue that for use for signalling purposes in the Abyssinian expedition the Magnesium Metal Company had received an order to manufacture 50 lb. weight of magnesium. It was intended to use the metal principally in the form of powder mixed with resin and lycopodium. The mixed dust was to be blown through a flame by a pair of bellows driven by a rotary handle, the arrangement being such that each time the handle was turned a flash was produced. The flame was to be made to appear at the end of a tall tube fixed on top of a man's head. With our soldiers turned in this manner into Roman candles, we anticipated that the magnesium lamp would prove as troublesome to the possessors as Mr. Pickwick's dark lantern. What with rockets and magnesium light, King Theodore and his subjects were, we remarked, likely to have some brilliant pyrotechnical displays at the expense of the British public. Another small sidelight on the history of the arrangements made for the conduct of the campaign was recorded in the statement that the swift little twin-screw ship Bolivar had been engaged by the Government to carry mules to Abyssinia. The vessel had had a somewhat adventurous career, for some time previously she had been seized at Chatham on suspicion of being a Fenian privateer.

The Lanarkshire Hydro-Electric Power Scheme.

No. II.*

THE Bonnington and Stonebyres station buildings, with the switchgear annexe, offices and dwelling-house, are practically identical, although, owing to the configuration of the ground, the position of the switchgear annexe at Stonebyres relative to the turbine house is not quite the same as at Bonnington. A drawing of the Stonebyres power house is given in Fig. 14. Ample space has been provided for dismantling either of the two sets by means of a 40-ton crane, which runs on rails 38ft. 9in. above the floor level. On a gallery, 12ft. wide and 8ft. above the floor level, the extra-high-tension control board is mounted, whilst the low-pressure alternating current and direct current switchboards are situated underneath this gallery. The 11,000-volt switchgear, booster transformers with regulating switchgear and the direct-current battery for operating the control mechanism, are all housed in a separate annexe situated on the downstream side of the turbine house. A portion of the building is set aside for the extra-high-tension switchgear, and is sufficient to accommodate twelve lines of main switchgear. Another section contains the station auxiliary transformers and the booster transformers for the main transmission lines, and switchgear for these booster transformers is situated on the floor immediately above. The workshop, offices, lavatory, &c., are placed at the upstream end of the turbine house, and immediately above is a three-apartment house for the senior station attendant.

As the Stonebyres station is difficult of access a reinforced concrete bridge, capable of carrying a load of 40 tons, had to be built across the Clyde. It is approached from the main road connecting Lanark and Hamilton, and it spans the river at a point approximately 73 yards on the downstream side of the power station. A roadway has also been built on the left bank of the river, giving access to the tilting weir from the Lanark-Hamilton main road.

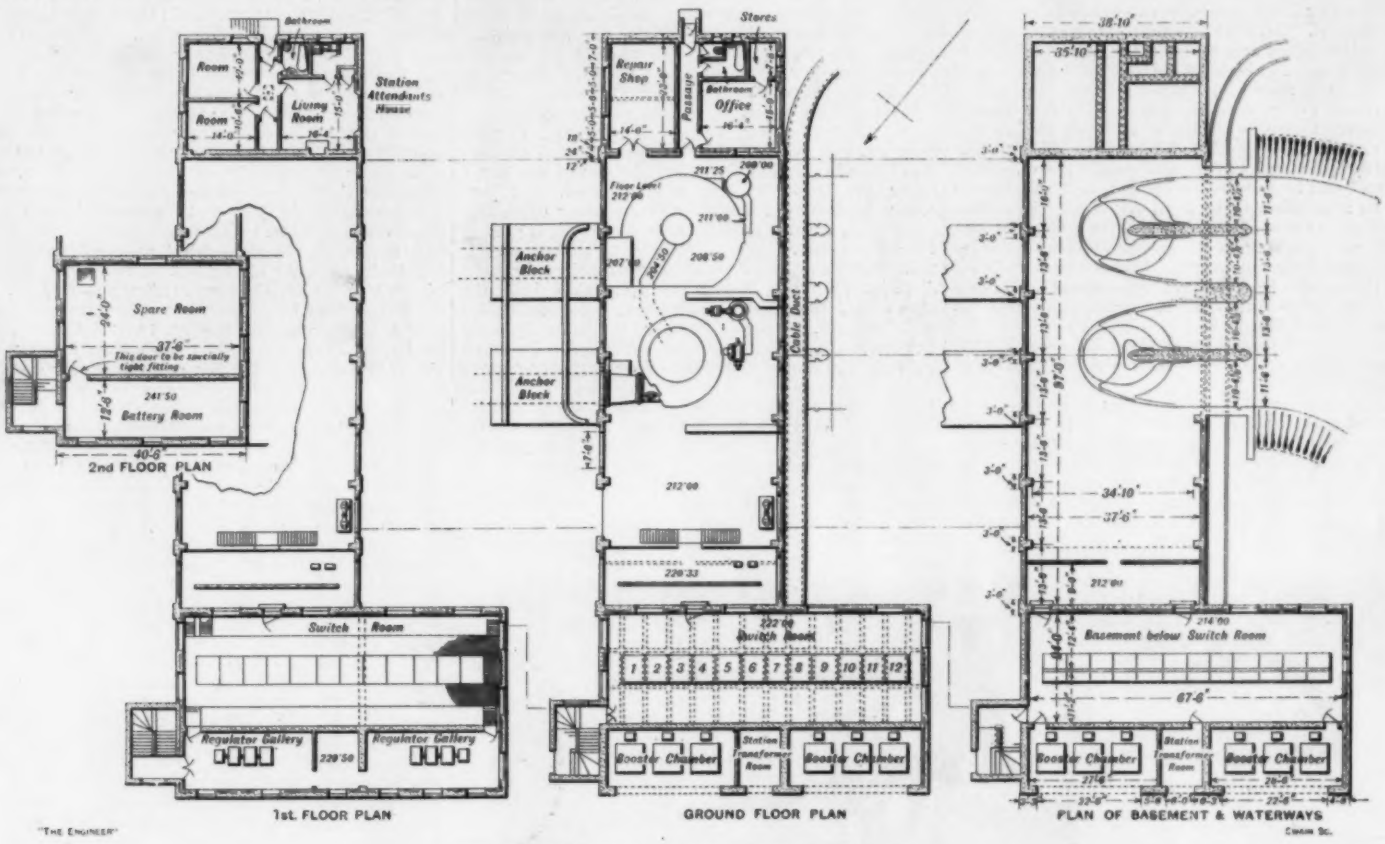


FIG. 14—FLOOR PLANS OF STONEBYRES POWER-HOUSE

A general plan and a section illustrating the works at Stonebyres are given in Fig. 15, which indicates the positions of the weir, the tunnel, power station and surge tank, which is shown in Fig. 19.

Coming now to the hydro-electric plant in the power stations, reference has already been made to the fact that on account of the fairly high head and the length of the pipe line at Bonnington, main valves of the cylindrical balanced type are provided at the turbines. These valves can be relied upon to protect the turbines in the case of emergency by cutting off the water supply, the purpose of the surge tank sluice gates in this case being to allow of draining the pipe line for inspection without emptying the tunnel. They are operated by an electric motor, and are fitted with an automatic release, which operates in the case of emergency. At the Stonebyres station, however, on account of the low head and short pipe line, there are no main balanced valves, although, in the case of emergency, the turbines are thoroughly protected by the surge tank sluices, which are capable of shutting off the water supply under all conditions of flow in the pipe lines. They are controlled on the remote system from the station.

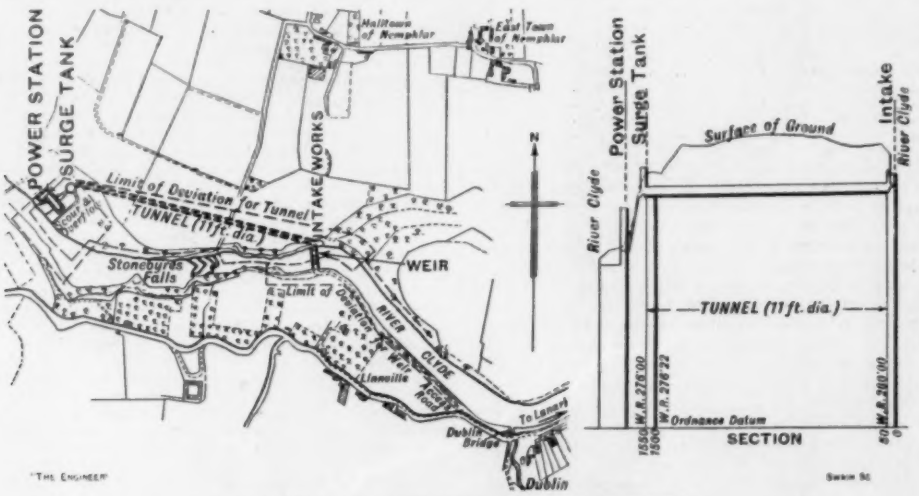


FIG. 15—PLAN AND SECTION OF WORK AT STONEBYRES

Each gate is operated by a vertical servo-motor, fed with oil under pressure from the power station oil pressure governing system. The servo-motor, which operates the sluices, is bolted to stools set in the wall of the surge tank, and the forged bronze piston-rod, which passes through a stuffing-box in the top of the cylinder cover, carries at its upper end a cross-head, which is connected by two vertical rods to the gate, the rods being guided by brackets fixed to the cylinder. By admitting oil under pressure to the top or the bottom side of the piston, the gate can be closed or opened respectively. Since, when closing, a large downward force can be exerted by the cylinder, in addition to the weight of the gate, the latter will completely close, even if there is a considerable rush of water through it, and to ensure tightness of the gate when it is closed machined faces of navy bronze are provided on the gate and on the cast iron gate frame.

Both stations are equipped with two vertical-shaft

FIG. 16—GENERATOR IN COURSE OF ERECTION

generating units erected on a single floor, this arrangement having been selected after consideration had been paid to the seasonal variations of the water at disposal, the variations in the load demand, and the arrangement of the pipe lines and their connections to the sets. The simplicity of the two-set arrangement with direct connection to the pipe lines is obvious. As both the stations will work in parallel with steam stations, their output will always be utilised to the

* No. I. appeared September 30th.

TURBINES FOR THE LANARKSHIRE HYDRO-ELECTRIC POWER SCHEME

FIG. 17—SPEED RING AND PARTS OF SPIRAL CASING—BONNINGTON

FIG. 18—COMPLETE SPIRAL CASING AND SPEED RING—STONEBYRES

fullest possible extent, and no gain would have resulted from increasing the number of sets. The employment of two sets results in a higher efficiency at all gate openings than that which would have been obtained if a larger number of sets of smaller output had been employed. As energy is always available from the steam stations, no spare sets are required.

Vertical-shaft generating units were selected because they call for less space than horizontal units; both the width of the buildings and distance between centre lines being smaller. The main crane is also cheaper because of its reduced span. Because of the higher regain of energy in the draught tube, made possible by the absence of a suction bend immediately after the runner—unavoidable in the case of a horizontal turbine—the efficiency of the turbine is increased. The single floor design of power station adopted eliminates the usual drawback of the vertical shaft design—namely, an upper floor for the generators, and a lower floor for the turbine. The sets in the two stations are designed to work under the following conditions:—

	Bonnington	Stonebyres.
Gross head	189ft.	97·5ft.
Net head	174ft.	91ft.
Output per turbine ..	7000 B.H.P.	4000 B.H.P.
Output per generator	4920 K.W. at 0·8 power factor	2840 K.W at 0·8 power factor
Speed	375 r.p.m.	375 r.p.m.
Frequency	25 cycles	25 cycles.
Voltage	11,500 volts	11,500 volts.

In the Bonnington Station the turbines are the most powerful reaction machines in Great Britain. The generators in both stations—see Fig. 16—are set on reinforced concrete pedestals, built round heavily-ribbed cast iron tapering stands, the upper flange of which is designed to serve as a generator bed-plate, whilst the lower flange is bolted to the turbine speed ring, as seen in the centre of Fig. 17, which transmits the weight down to the foundations. Three openings in the pedestal give ready access to every part of the turbine. Air for cooling the generators is also drawn through these openings, and is discharged at the top of the generator, and since the cold air is taken in near the floor, and the hot air is discharged at a much higher level and escapes near the window near the roof of the building, there is no chance of the hot and cold air mixing.

All the regulating gear for each turbine, *i.e.*, the oil pressure governor and pumping set, with the addition of a relief valve at Bonnington, is placed on the downstream side of the power house. The governor is also close to the concrete pedestal, and is connected to the turbine through one of the openings. The main passage runs along the downstream side of the building past all the regulating gear, and has a width of 5ft. to 6ft.

The fact that the turbines and generators were built by the same firm greatly facilitated the design, and co-operation between the different departments resulted in various simplifications. The generators have two bearings, a thrust and journal bearing, and the turbine a guide bearing—a form of construction made possible by the single floor building, which reduces the distance between the turbine and the generator to a minimum. By avoiding the use of a separate alternator bed-plate a considerable saving was made. The time necessary for dismantling and overhaul has been reduced by making the bore of the generator stator sufficiently large to allow the turbine runner and the complete main turbine cover—to be seen in Fig. 20—to be passed through the generator stator after the generator rotor has been removed, and this also permitted making the main cover in one piece instead of two. A common oil pump and lubricating system serves for lubricating the generator and turbine bearings.

As far as the general design is concerned, the single runner reaction turbines in plate steel spiral casings are very similar in the two stations, but at Bonnington the diameter at the casing entrances is 4ft. 10in. and 6ft. 6in. at Stonebyres.

In both cases the casings are composed of welded steel boiler-plate. After negotiations with Thompson Brothers (Bilston), Ltd., of Bradley Works, Bilston, the makers of the turbines—the English Electric Company—decided to adopt a welded construction instead of a riveted construction, and to place the welding work in the hands of Thompson Brothers. There are no overlapping plates inside, for all the joints were butt welded, and butt straps were provided on the outside. The absence of rivet heads helps to keep the surface smooth, resulting in high efficiency. A centre jig was supplied by the English Electric Company, similar in shape to the final speed ring. The circumference was marked and drilled to suit the plates to be bolted to the speed ring. Gauges were also made from the drawings supplied, and dies were made accurately to curve the backs of the plates. An external jig was constructed and fixed at the proper distance from the centre jig, and the plates as rolled, and set to gauge, were slipped into place between the centre and outer jig until a considerable number had been assembled, when they were welded up by means of 50-cycle alternating current. The various sections of plates were first tacked in place and then removed to the shop floor in sections, where they were quickly welded, while another section of plates was being prepared. As no riveting had to be done, elaborate and heavy jigs were unnecessary; in fact, for the most part the jigs consisted of light angle iron. No distortion difficulties were experienced because precautions were taken to avoid them. Other sections of the casings were similarly prepared and welded, but on account of transport difficulties the casings had to be made in halves and sent to Lanark and welded together on the site—as shown in Fig. 18—when the casings were then filled and tested at 700 lb. and 1300 lb. per square inch at Stonebyres and Bonnington

FIG. 19—SURGE TANK AND SPILLWAY AT STONEBYRES

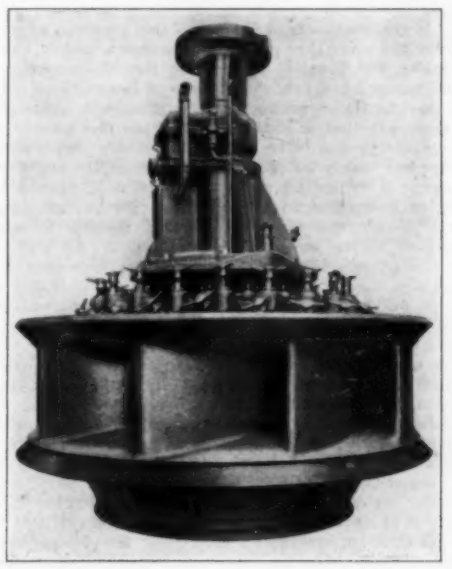


FIG. 20—7000 B.H.P. TURBINE FOR BONNINGTON

respectively. At these pressures the casings proved to be absolutely dry.

The spirals are of the logarithmic shape, which means that the area of their successive sections is so reduced that a smooth and regular intake vortex is obtained all round the gate apparatus. Where necessary, the plates are stiffened outside against the water pressure by angle irons, which are welded to the casing. As shown in Fig. 18, the casing plates are bolted to a cast iron "speed ring," consisting of an upper and lower guide piece joined together by streamline webs, and this "speed ring" is extended right down into the draught tube.

(To be continued.)

The Locomotive Industry.

(By a Correspondent.)

In the following article a correspondent who is familiar with the locomotive industry comments upon Mr. Gresley's recent address to the Institution of Locomotive Engineers. Whilst we are not prepared to endorse all that our correspondent says, he expresses views which are so widely held that we deem it right to allow him to lay them before our readers.

On Thursday evening last, Mr. H. N. Gresley, the new President of the Institution of Locomotive Engineers, delivered an address which had for its subject the present position of the locomotive building industry. As was to be expected, a large number of members turned up to hear Mr. Gresley, who is so well and favourably known in the world of locomotive engineering.

After reviewing the position in the locomotive business at the end of the war and referring to the increase in the capacity of the firms interested in this particular work, Mr. Gresley developed a brief study of the various proposals now coming forward for the substitution of the present form of steam locomotive by other designs, and mentioned the oil engine and the steam turbine as possible rivals in the future. He touched also upon the chances of railway electrification. After these various points had been dealt with Mr. Gresley proceeded to discuss the question of increased efficiency, and pointed out that, in a general way, further power was not required. What was wanted was a more efficient use of the fuel. It was of importance from the commercial point of view that British locomotive designs should compare favourably with those of other countries, and, speaking of progress, Mr. Gresley admitted that new ideas were slow in being taken up, but he asserted that while the evolution of ideas and the adoption of new principles was a slow process, it was, nevertheless, sure. Finally, Mr. Gresley, in stressing the great necessity for improvements in the design of locomotives with a view to their greater working efficiency, made the suggestion that a national plant for the testing of locomotives should be provided in order that a more complete study of the steam locomotive might be made. The testing plant, he suggested, should be under independent control and railway companies and private manufacturers should be able to send engines for the purpose of being tested. In support of this scheme it was contended by Mr. Gresley that, already, facilities existed for proving the shape of ships, and other apparatus was available for the testing of aircraft; therefore, why not a national plant for locomotive trials?

Whilst Mr. Gresley's opening address was distinctly of interest, it must be admitted that in many respects it was a disappointment. In dealing with the present state of the locomotive building industry and pointing out the unsatisfactory condition of affairs, he was only able, in offering an explanation, to tell us what we already very well know. It must be remembered that the railways of this country, now in four groups, do very little to help the manufacturers, and that the latter have suffered greatly by the suppression of the large number of the smaller home lines which were their customers. Manufacturing establishments have now to look more largely than ever overseas for their business, and owing to the attitude taken up by those countries, which at one time obtained almost all their railway material here, this business is now only obtained in the face of strong competition. There is yet one other reason why home railways are of little value to private firms, and that is the reticence displayed in allowing concise information to be published as to the actual working of British locomotives. This is more serious than might be at first thought to be the case. It means that, actually, general knowledge of this important subject is based almost entirely on American, and in a lesser degree on German, data. The result being that British designs are rapidly disappearing, the only country now using purely British locomotive types—that is, engines built according to British ideas—being India. All others are fast adopting the North American style of construction.

The railways in this country are of recent years notoriously slow in coming forward with anything new themselves, and in actual practice most real improvements have been introduced to their notice by firms quite outside the railway business. Why this should be is difficult to say, but there may be good reasons. One may be the large extra responsibilities thrust on chief mechanical engineers, and the increase in routine brought about by the new railway systems. They have perhaps not the time to give to the study of new details and ideas which are being developed by outside sources. A central body formed to study and report upon new ideas might be of value, but before such could be the case the railway engineers would have to make up their minds to leave their water-tight compartments, for until they have decided that their knowledge must be everybody's, the idea of a national locomotive testing plant under independent, Government, or any other control can be forgotten, for its value would in practice be nil.

Obituary.

FRANK CLINTON WIGHT.

We desire to extend our sincere sympathy to the staff of our United States contemporary, *Engineering News-Record* and to the McGraw-Hill Publishing Company, Inc., on the untimely death of Mr. Frank C. Wight, the distinguished editor of that journal. Mr. Wight, who had but recently recovered from a nervous breakdown brought about by overwork, was suddenly attacked by a throat affection, and died after only a few days' illness on September 18th at his home in Summit, New Jersey.

Frank Clinton Wight was born in Washington, D.C., on February 26th, 1882. He was therefore only in his forty-sixth year at the time of his death. He studied first of all at the Columbian—now the George Washington—University, and later at Cornell, where he received the degree of Civil Engineer in 1904. After graduation, he spent three years in the office of the Engineer of Bridges of the District of Columbia, his previous summer vacations having been spent in that District's Surveyor's office. While on the staff of the Engineer of Bridges he had rendered important services in connection with the design and construction of the Piney Branch and of the Anacostia bridges, as well as of the great Connecticut-avenue viaduct over Rock Creek Valley.

Just about that time *Engineering News* was on the look-out for a young engineer of exceptional ability to join its staff as a junior editor. The name of Frank Wight was brought to its notice as being a young man of great promise, and in December 1906, he became a member of its staff, his principal work at first being in connection with concrete design and construction. Reinforced concrete was then in its youthful development in the United States and was a difficult subject to deal with editorially in a technical journal. The task was, however, allotted to him, and the manner in which he performed it showed how well founded had been the belief in his ability to do the work satisfactorily. Later he was also put in charge of matters concerning river and harbour work.

His rise in the editorial ranks of the paper was phenomenal, for in 1913, or in less than seven years after he entered its service, he was made editor. Those who remember the high standard maintained by *Engineering News* at that period may well marvel at the information that it was being directed by a young man who was only thirty-one years of age. From the first he had displayed the qualities that distinguished his career throughout. Among them was a tremendous capacity for work, which was the result of a marvellous ability to work with great speed and yet with absolute accuracy. He was able, almost as soon as he joined the paper, to take up important work, whether in the office or on inspections, and to write articles or comments which, practically without any editing, could be sent to press. He could write with force and elegance, and he adapted what he had to say and his method of saying it to the subject and to his readers. He was, in fact, not only a born journalist, but a born editor as well. He is described, moreover, as being possessed of extraordinary human and administrative qualities; as being quick to act—after careful and yet not too lengthy deliberation; and as being as sympathetic and conscientious as he was prompt. Those qualities, which had already shown themselves when he held a comparatively junior position, ensured him instant success when he became commander in chief.

For the four years between 1913 and 1917 Mr. Wight retained his position as editor of *Engineering News*, until 1917, when that journal was combined with *Engineering Record*, under the title of *Engineering News-Record*, and Mr. E. J. Mehren was appointed editor of the new publication. He then returned to more strictly technical work. However, it was only for four years that he was thus to be employed, for at the expiration of that time he was made managing editor. Then, when, in 1924, Mr. Mehren was promoted to executive work, Mr. Wight was appointed to be his successor. It is said that his appointment was the unanimous choice of both editorial staff and executive management.

For only three years was Mr. Wight destined to fill this new position—the highest which the journal could offer to him—but those years were years of great endeavour. Almost as soon as he entered upon his new duties, he was called upon to produce a special issue to commemorate the fiftieth anniversary of the existence of his journal. Of his efforts in that direction it is reported that the issue he produced was "an achievement which brilliantly certified the wisdom of his choice for the position of editor." Then, throughout the period of strong, flourishing growth of the paper in the following years he is said to have displayed even more fully than before the combination of editorial vision, ability to plan, power to inspire and convince, and sure critical judgment.

Besides his editorial work, Mr. Wight took part in many outside activities. He served on many technical committees and councils. He was for years a leading member of the American Concrete Institute, of the "Proceedings" of which he was editor. He was a member of the American Society of Civil Engineers and served on some of its important committees. He was also a member of Mr. Hoover's Committee on Highway Traffic Safety. Quite lately the National Fire Protection Association requested him to be chairman of a committee on the fire protection of construction work, and his journalistic colleagues honoured him by electing him chairman of the New York Editorial Conference and President of the National Conference of Business Paper Editors.

But there is a point beyond which the human frame cannot be stressed. His numerous activities, entered upon because his apparently boundless energy urged him forward, at length led him beyond the elastic limit, and the breakdown already recorded was the result. Barely recovered from that, he returned to work, and with weakened constitution he succumbed to a malady of the throat. Thus passed away, in what may be termed the period of life when many are at their prime, a man who had already made a great name in technical literature, but who, to all seeming, was destined for much greater things.

SVANTE ARRHENIUS.

Within a few months' time, the Swedish Academy of Science has lost two of its most brilliant members—Gosta Mittag-Leffler and Svante Arrhenius—one a pioneer in the realms of pure mathematics, the other one of the founders of the exact science of chemistry. The latter was probably more universally known, as his work was fruitful in a domain of science which appeals to popular imagination, electro-chemistry. Svante Arrhenius was born near Upsala, on February 19th, 1859, and was, hence, only sixty-eight years of age at his death. He matriculated as a student at the ancient university near his home in 1876, where he graduated as PhD. in 1884. His dissertation "Recherches sur la Conductibilité Galvanique des Electrolytes," which was to give him universal fame, was, however, prepared in the laboratory of the Academy of Science at Stockholm, then in charge of Edland, the propounder of the single fluid theory of electricity. In this dissertation he outlined the modern theory of electrolytic dissociation, though he then was careful to use the uncompromising expression "activity" coefficient for the dissociation constant, which he afterwards employed in 1885. Arrhenius' dissertation was discussed by Sir Oliver Lodge in 1886—Report, British Association—and by many others so exhaustively that his fame grew apace, and the dissociation theory became universally accepted. The wider application of this theory to chemistry in general was furthered by its originator's association with Ostwald at Riga and Leipzig, and with Kohlrausch at Würzburg, somewhere about 1890. His later work was devoted to cosmic and climatological physics, but he never got another, what Berzelius called "pensée heureuse," that happy thought, which generally comes about once in a lifetime, even to a genius. Arrhenius became professor of physics at Stockholm University in 1895, he received the Nobel Prize for chemistry in 1903, and he was an honorary member of the Royal Society and of numerous other scientific bodies all over the world. He carried out several public missions, one of which was a report on the utilisation of water power for electric railway traction on the Continent in 1901 to the Swedish Waterfall Committee.

With his death the ranks of the nineteenth century Upsala school of science has lost one of its last survivors, but there is a vigorous new one growing up in the old traditions of Linnæus and Berzelius' famous university. There are some who would class Arrhenius with these, but even if he did not characterise his period in science as his own like those two, he shed lustre on the repute of his own land by an original thought which has helped to bridge the gap between the old empiric sciences and the modern approach to an exact one, embracing all the others.

The Colombo authorities have under consideration a scheme for the reclamation of swamps by pumping dredged material from the harbour and rendering the area suitable for cultivation and building purposes. The harbour engineer is of opinion that the scheme deserves consideration, but it will be an expensive one. At the same time the work executed at Karachi shows that it can be successfully done and that the initial cost would be about Rs. 14 lakhs. Another proposal is to excavate the proposed wet dock basin, comprising an area of 115 acres, with a view to increasing the accommodation of the port and to use the material thus obtained to fill the low-lying area.

Railway Matters.

THE South African Railways and Harbours Administration is calling for tenders for no less than 125 new locomotives ranging from big "Garratts" down to shunting engines.

FROM the beginning of the year to September 25th the London and North-Eastern Railway ran 2850 special half-day excursions, which carried 1,150,000 passengers. The company considers that so successful that such trains are to be continued.

THE vacancy in the Ministry of Transport's inspecting officers of railways, caused by Colonel Hall having become the assistant engineer (signals and telegraphs), Southern Railway, has been filled by the appointment of Major A. H. C. Trench, C.I.E., R.E.

THE 7.50 p.m. West Coast express from Aberdeen to Euston narrowly escaped a serious disaster on Monday evening. It consisted of eleven coaches, drawn by two engines, and when running between Muchallo—11 miles south of Aberdeen—and Stonehaven, the second engine and four following coaches left the rails. The couplings apparently held, as the train kept fairly in line, but when it came to a stand the derailed vehicles were being kept up by the parapet of a bridge.

THE retirement, after fifty-two years' service, is announced of Mr. T. R. Orme, the assistant marine manager (Southampton) of the Southern Railway. Mr. Orme was mainly responsible for the introduction, in 1910, of the geared steam turbines of the Parsons type in the Sarnia and Ceasarea, when built by Cammell, Laird and Co., Ltd., for the Southampton–Havre service. Mr. Orme claimed that the London and South-Western was the pioneer company in the use of that turbine for all purposes in passenger vessels.

THE dependence upon the railways for the food supply of the nation is well known, although the general strike last year proved that road motor vehicles reduced it. Some figures as to the milk traffic for London will therefore be instructive. The Southern Railway, it seems, brought to London during the year ended on June 30th last no less than 1,469,312 loaded churns of milk. The chief reception stations are Clapham Junction and Vauxhall, and to the former 747,737 churns were conveyed and 568,346 to the latter. Waterloo received 139,850 and the South-Eastern stations at London Bridge and Victoria 7760 and 5152 respectively.

IN the last issue of the reports of the inspecting officers on railway accidents, there was one by Mr. Moore, an assistant inspecting officer, on fatal injuries received by a stationmaster on a light railway. He was engaged in shunting operations, and when that work had to be performed a portion of the train had to stand on an underbridge which had no path at the side. The railway is of 3ft. gauge, and the wagons have a central coupling. The train has therefore to be stopped specially when off the bridge for the man to go between the wagons to uncouple them or he must do so whilst the train is in motion. An equally noteworthy feature is that the rule book does not contain the standard rule warning men against going between moving vehicles.

ACCORDING to the Board of Trade returns the value of the railway material exported during the first eight months of the present year was as follows, the corresponding figures for 1926 and 1925 being added in brackets:—Locomotives, £1,225,891 (£2,434,950, £2,049,796); rails, £1,909,684 (£1,236,702, £1,347,586); carriages, £2,243,354 (£1,970,219, £1,032,841); wagons, £1,710,915 (£2,201,598, £2,280,163); wheels and axles, £441,216 (£356,135, £401,974); tires and axles, £390,118 (£207,980, £289,351); chairs and metal sleepers, £900,075 (£602,094, £572,128); miscellaneous permanent way, £1,024,514 (£785,157, £896,617); total permanent way, £4,849,446 (£3,325,119, £3,621,211). The weight of the rails sent overseas was 232,654 tons (156,438 tons, 142,333 tons), and of the chairs and metal sleepers, 90,591 tons (62,254 tons, 50,870 tons). During the month of August last the value of the locomotives exported was £111,744, which included:—India, £27,615; South America, exclusive of the Argentine, £11,750; the Argentine, £7003; South Africa, £1776; and Australia, £1200. The value of the rails exported in August was £364,232, and included:—India, £157,149; the Argentine, £74,997; Straits Settlements, £12,126; Chili, £7916; Australia, £7678; South Africa, £7653; Portuguese East Africa, £3657; Ceylon, £2044; New Zealand, £1496.

THE recent annual report of Colonel Sir John Pringle on the railway accidents of 1926 led to a letter from Mr. Stenson Cooke, of the Automobile Association, in *The Times* of September 22nd. It was therein said that "no fewer than 141 cases are recorded of trains running into gates or vehicles at level crossings, and fifty-nine people were killed in these level crossing accidents." Mr. Cooke has, however, confused the figures. In the 141 cases of trains striking gates or vehicles, eighteen people were killed, and those figures compared with twenty killed in 135 similar instances in 1925, and with ten killed in 145 accidents in 1924. The fifty-nine killed mentioned by Mr. Cooke were those who were run over at level crossings, of whom forty-one were pedestrians crossing the line. Moreover, twenty-one of the pedestrians were doing so at footpath crossings, *i.e.*, where there was no carriage road, whilst a further seven pedestrians were killed at occupation crossings. It is true that seventeen occupants of road vehicles lost their lives by collisions with trains, but seven of them were at occupation—*i.e.*, private—level crossings. As Sir John Pringle points out in his report, "no responsibility is placed upon railway companies by legislation for safeguarding movements of road vehicles or pedestrians" at occupation and footpath level crossings Only in the case of public road level crossings can pressure be brought to bear, and as, out of the twenty-four killed there, thirteen were pedestrians and one was a railway servant, there were only ten occupants of road vehicles concerned in the question of the abolition of such crossings—the object of Mr. Stenson Cooke's letter—of whom nine were killed at Naworth and one at Roudham.

Notes and Memoranda.

ACCORDING to Dr. P. A. Wagner, diamonds have been discovered at intervals along 600 miles of the coast of South-West Africa. He therefore considers it one of the most remarkable stretches of coast line in the world.

WHAT is claimed to be the largest steel girder yet made in South Africa was recently put in place in the new Standard Bank building, Durban. It is 60ft. long, 6ft. 8in. deep and 18in. wide, and was made by Wade, Dorman and Co.

THE report of the Forest Department of the Union of South Africa for 1925–26 states that the area reafforested by the Department during the year under review was the largest annual planting ever accomplished in South Africa, the area being 15,276 acres, or 2044 acres more than in the previous year.

WHAT is claimed to be the tallest concrete chimney stack in North America has recently been finished at the Smelter of the Horne Copper Corporation, Quebec. It stands 409ft. high, is 31ft. in diameter at the bottom, and 20ft. at the top, outside. The internal diameters are 25ft. and 18ft. respectively.

THE new motor lifeboat of the Royal National Lifeboat Institution, which is to be stationed at Piel, at the entrance to Barrow-in-Furness Channel, has just completed her trial trips. She is of the latest Watson cabin type, 45ft. long, driven by two 40 H.P. engines. She was built at Cowes, Isle of Wight, and is the first motor lifeboat to be stationed on the Lancashire coast.

FIGURES showing the state of telephone development in nine leading countries are published in the current issue of the *Telegraph and Telephone Journal*. It appears that Denmark, with one telephone to every ten inhabitants, is the best developed of European countries, and France, with one to 47½, is the worst. Great Britain, though third, so far as the actual number of telephones is concerned, with a total of 1,510,775 at the beginning of this year, has one telephone to every 29 inhabitants, and is thus only seventh in the matter of telephone density. Germany has the largest number of telephones in Europe, and with a proportion of one telephone to every twenty-two inhabitants, stands sixth in the density list.

A VALUABLE booklet has been issued by the Factory Department of the Home Office on "Annealing and Use of Wrought Iron Chains." The information is based on the results of experiments conducted at the National Physical Laboratory. Chain accidents are largely ascribed to brittleness due to skin hardness and to defects in manufacture, failure to examine chains, and ignorance as to what is a "safe load." This booklet contains essential facts that should be known by all chain users, and should be in the hands of both employers and workmen. Its price is only 1d., and employers throughout the country would be well advised to purchase and distribute copies to those whom they employ. It will enable the workman concerned to take an intelligent interest in his work, and if the advice is followed will undoubtedly lead to a diminution of accidents.

THE Australian Federal Minister of Works and Railways (Mr. Hill) states that the excavations for the foundation of the main dam at Hume reservoir on the Murray River are nearing completion. All possible haste is, according to the *Industrial Australian*, being made with the construction of the Bethanga Bridge, which is being built across the Murray, and part of the reservoir, to give way of access between Victoria and New South Wales, because no water could be impounded in the reservoir until the bridge was complete. The bridge, which is to be a steel structure on concrete piers, will be built in seven spans of 250ft. each, a total length of 1750ft., and with approaches it will measure nearly half a mile. Its width will be 20ft. About 1000 men are employed on the building of the dam and the bridge. It is estimated that the reservoir will be complete by 1930, but it will be ready for partial use before that time.

GREAT strides, states the *Electrical Times*, have been made recently in the application of electric power in the tin and other mining industry. A feature of this development is the extensive use of oil engine driven generators. Their use frequently effects very large reductions in power costs. So far has the adoption of electric power progressed that it may now be regarded as present-day practice to equip, in conjunction with the mines, a power house with several electric units, designed for parallel operation, so that the varying loads can be economically met. To enable distribution of the power generated to be effected in the cheapest and most efficient manner, alternating current is adopted. This is due to the fact that in most cases it is necessary to carry transmission lines a matter of some miles from the mine to the mills, necessitating very high voltages, which automatically rule out direct current. The system of central generation obviates the disadvantages of a number of very small prime movers with their independent fuel supplies, cooling arrangements and extra attendance.

A NOTE in *Nature* gives the following extract from an article in *Chemiker-Zeitung*, of August 10th, containing an account of recent developments in the art of chromium plating, which has hitherto been attended with serious difficulties. Not only has it been possible by the use of suitable electrolytes to reduce both the quantity and the density of the current to reasonable dimensions, but also the disturbing effect of the hydrogen evolved at the cathode has been recently eliminated, without the application of heat by a new process patented by Dr. von Bosse. It has been ascertained that the amount of hydrogen occluded by the chromium increases very considerably with increasing current density and frequently cracking and scaling of the deposit takes place. The chromium-hydrogen alloy thus produced can, however, be broken down by the application of a high-tension alternating current in a highly evacuated chamber, when light is emitted and in the course of a few minutes the hydrogen is completely eliminated as gas. The end of the process can be recognised by observing the change which takes place in the character of the light emitted. The necessary apparatus is supplied by the firm of Langbein-Pfanhauser, of Leipzig and Vienna.

Miscellanea.

ARRANGEMENTS have been made to re-open the old quarries on St. Alban's Head, near Swanage, Dorset.

A NEW colliery is to be opened up near Bowral, Mount Murray, New South Wales, by the Hoskins Iron and Steel Company.

A LARGE deposit of magnesite is being opened up at Kunwarara, north of Rockhampton, on the Queensland North Coast Railway.

THE Union-Castle liner Kinfauns Castle, of 9656 gross tons, built at Glasgow in 1899, has been purchased by a Rotterdam firm to be broken up.

THE work of dredging the new Western approach to Southampton, to a depth giving a draught of 35ft. over a width of 1000ft. has now been finished.

THE publicly-owned electricity distribution lines of Ontario are being extended at the rate of three miles a day, while the load on the plant is growing at the rate of 100,000 horse-power a year.

ARRANGEMENTS are being made for extensive development of the large deposit of molybdenite which occurs on the property of the Molybdenite Reduction Company at Lake Malartic, South Amos, Quebec.

THE general programme of the International Exhibition, which is to be held in Antwerp in 1930 is now being actively prepared. It appears that the general tendency of the exhibition will be towards Colonial affairs.

ACCORDING to a statement just issued by the Dominion Bureau of Statistics, production of sulphuric acid in Canada in 1926 totalled 108,230 tons,66 deg. Be, valued at 1,306,254 dollars, as compared with 83,396 tons worth 1,363,618 dollars in 1925.

A COMPANY has been formed in Auckland, New Zealand, for the distillation of the lignite mined at Waikato by the Debauche process. It is expected to obtain as by-products 11½ gallons of heavy oil and 2¾ gallons of motor spirit per ton of raw lignite treated.

FOR the second time within fifteen months the 50,000-ton floating dock of the Southern Railway, stationed at Southampton, has had to be taken away from its berth in order that its bed may be dredged of accumulated silt. The depth necessary for its full submergence is 75ft.

A COMPANY has just been registered in Glasgow, with a capital of £1,000,000, with the object of exploiting a new process of preparing flax for textile purposes, which is said to eliminate the process of retting and to reduce the time required in preparing the material in the proportion of at least 12 to 1.

IN order to permit the rail transport of one of the bedplates for the engines of the oil tanker Schuylkill, which is being built by Sir James Laing and Co., and is being engined by Doxfords, as much as 100 miles of railway between Sheffield and Sunderland had recently to be cleared of all other traffic.

THE designed capacity of the Gatineau Power Company, Canada, at 600,000 horse-power, is now greater than that of the plants on the American side of the Niagara Falls. The company is working thirteen stations, and has over 360 miles of high-tension power transmission lines covering an area of nearly 5000 square miles.

DURING the first eight months of the year the total production of pig iron in France was 6,179,570 tons. In this amount Thomas pig accounted for 4,715,850 tons, and foundry iron 1,077,693 tons. On September 1st there were 142 furnaces in blast, out of a total of 218. The production of raw steel during the eight months was 5,440,545 tons.

THE new wireless station at Ruysselede, which lies between Ghent and Bruges, has just been opened. It has been erected in order that Belgium may communicate directly with the Congo and America. The new station can use, at will, either long or short wave lengths. The station covers an area of 358 acres. The aerials are slung between eight pylons each 930ft. in height.

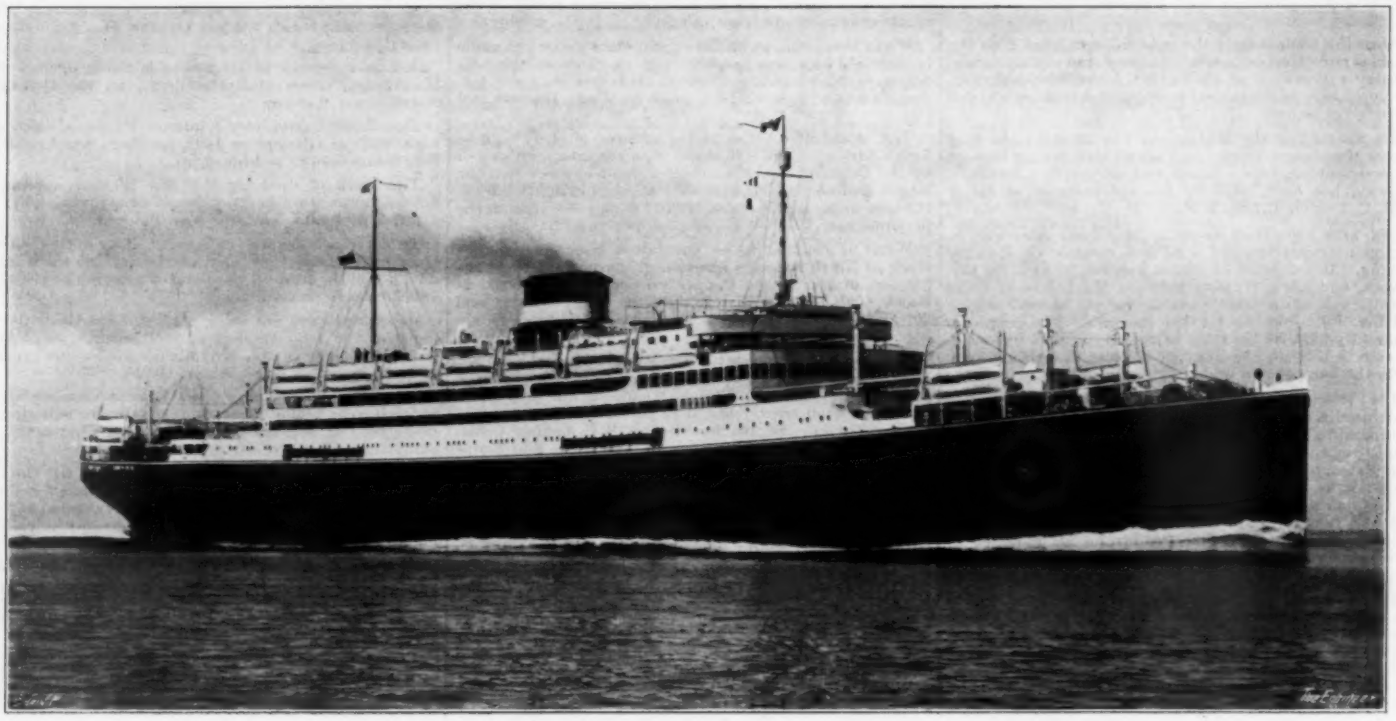
AN end has come to the cable tramway at Matlock, which was a free gift from the late Sir George Newnes to his native town and had served the town for over thirty years. The Council had resolved to abandon the undertaking and to substitute an omnibus service, when the tramway suddenly brought itself to an end by the cable breaking. Omnibuses are now running over the route. The undertaking cost Sir George Newnes £30,000 and had been running at a loss for many years.

AFTER attending the League of Nations Conference at Geneva as one of the Canadian Government representatives, the Hon. Chas. Stewart, Minister of Mines, will turn his attention to the progress being made in Europe in the treatment of lignite and bituminous coal for by-products. Dr. Chas. Camsell, deputy minister of the department, will join Mr. Stewart, and together they will visit producing plants in Germany, where oil is produced from coal, and will look into the work being done by the British Fuel Research Board at Greenwich, as well as visit the extensive plants in operation in England and Scotland for the treatment of coal. If time permits they will also visit the peat bogs of Holland and Denmark to inquire into the feasibility of profitably developing the extensive deposits of Ontario.

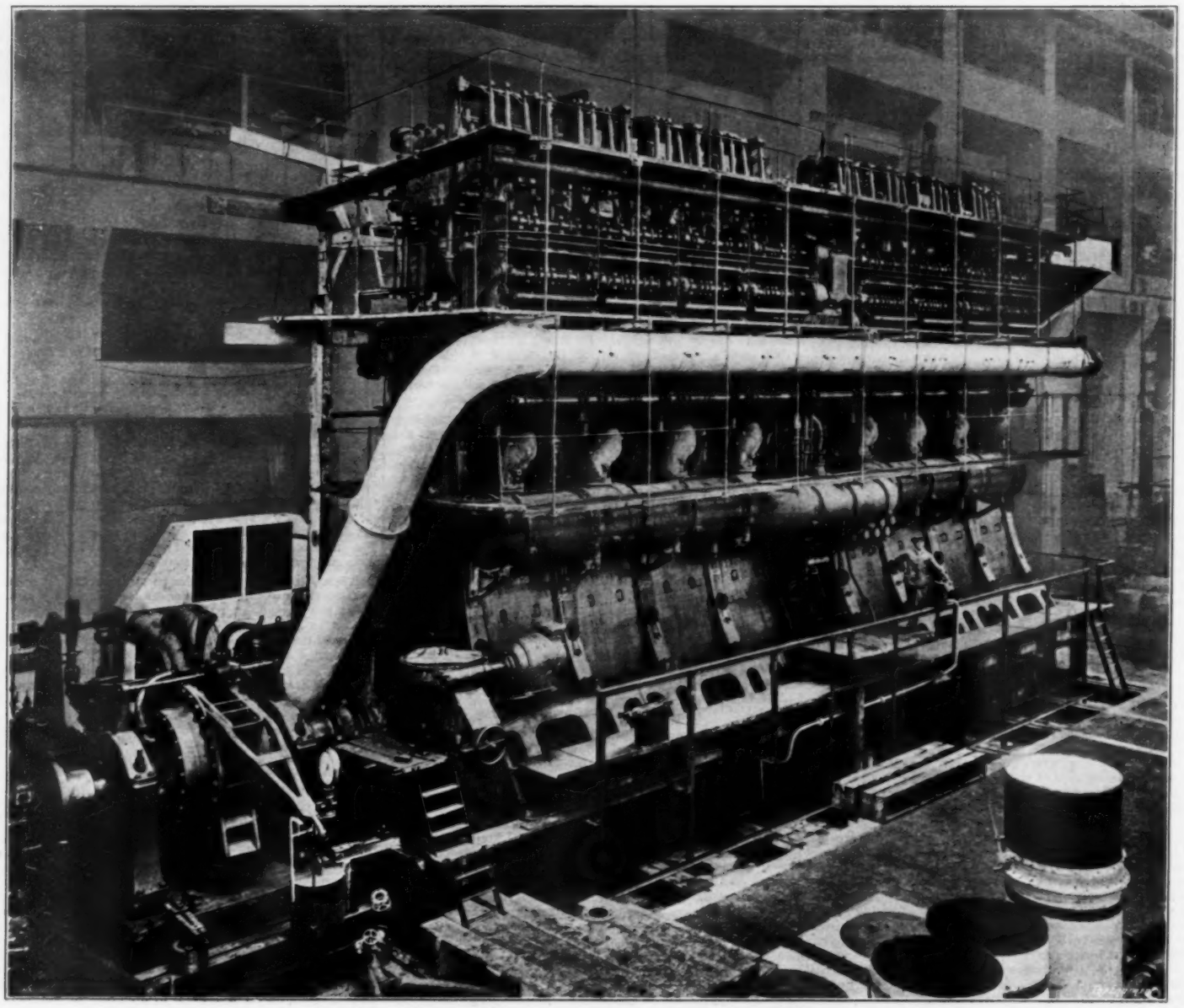
AMONGST the construction work on electric power plants now going on in Sweden, there are four important stations being completed. They are the Hammarforsen, Krangfors, Lanforsen and Munkfors plants, of which the Hammarforsen is the most important. The aggregate power delivered by these four plants will amount to fully 130,000 kilowatts. The Hammarforsen Power Company will ultimately be able to develop 67,500 turbine horse-power. This station is designed to meet the increased demand for electric energy in the district of lower Norrland. By combining its own transmission lines with those farther south it will also deliver power to Southern Sweden. A number of private owners of smaller waterfalls are also harnessing their falls for local distribution of power in their individual communities in all parts of Sweden, and thus help to attain the national goal of making Sweden practically independent of imported fuel.

THE 24,000-TON TWIN-SCREW MOTOR LINER SATURNIA

(*For description see page 406*)



THE SATURNIA ON HER TRIAL RUN



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The Engineer

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THE ENGINEER.

OCTOBER 7, 1927.

The South-East England Electricity Scheme.

A NEW electricity scheme, covering South-East England and including the electricity district administered by the London and Home Counties Electricity Authority, has been issued by the Commissioners. We are told that, under its operation, in five years, 1929–1934, there is to be a saving to the undertakers in the area of nearly five million pounds, a saving that will increase with lapse of time. Eleven counties and parts of three other counties are to be served; no fewer than 8828 square miles are involved. Over eleven and a-quarter million people are to enjoy a cheap supply of electricity. The densely populated metropolitan area and many residential towns in the suburbs on the coast, the industrial area on both sides of the Thames, the London docks, the potential coalfields in Kent, a considerable mileage of electrified suburban lines, tubes, &c., besides wide strips of rural and agricultural country, come within the scope of the scheme. The present consumption of about 112 units per annum per head of population is expected to increase to 265 units in 1933–34, and to 426 units in the year 1940–41. Within the area there are at present 165 authorised undertakers, owning between them 135 stations. Ultimately, the area will be supplied by eighteen capital stations, thirteen of which are already in existence, two are projected, and the remaining three will be quite new. The riverside stations at Battersea, Barking, Chiswick, Deptford and the new Brimsdown station will probably carry the main load. Needless to say, the scheme involves an interconnecting system of high-pressure main transmission lines, to be precise 132 kV lines, supplemented by sundry transmission lines working at a lower pressure, suitable for supplying the various undertakings concerned with distribution. The interconnection of the stations is expected to result in the release for revenue earning purposes of about 245,175 kilowatts of plant now kept as spare, representing a sum of about three million seven hundred thousand pounds of capital. As the main facts concerning the scheme have already appeared in the daily Press, we scarcely need go into all the details. The usual publications, containing maps, diagrams and tables galore can be obtained at his Majesty's Stationery Office.

From a part of Great Britain, namely, Central Scotland, where, on account of the presence of a considerable amount of 25-cycle plant, appreciable difficulties will have to be faced, the Commissioners have turned their attention to an area which so far as the interconnection of power stations for public supplies is concerned, will present relatively little difficulty. In South-East England there is less non-standard frequency plant than there is in certain other parts, and as this plant is not considered to be an obstacle to the proposed transmission scheme, frequency standardisation does not figure in the estimates. Not very long ago great stress was laid upon the advantage of combining traction and industrial loads, yet traction stations—such as the Lots-road station, the Neasden station of the Metropolitan Railway, the Greenwich station of the London County Council tramways, the Wimbledon station of the Southern Railway, and others—will not apparently be affected by the scheme, although the Board will supply current to future electrified lines. The fact of the matter is that the complete standardisation of frequency is commercially impracticable. The task—if ever it is accomplished—of changing all the generating plant and consumers' motors and meters in the Clyde Valley, in Glasgow, on the North-East Coast and at Birmingham, will prove difficult and costly enough without interfering with existing 25 and 33⅓-cycle traction generating plant and changing non-standard frequency rotary converters and transformers in sub-stations in various parts of the United Kingdom. There is no doubt in our mind that as these electricity supply schemes begin to take practical form the difficulties associated with them will be better understood, and ideas will have to be modified. Incidentally, in a report which accompanies the Government's publication containing the supplementary particulars of the Central Scottish scheme, the ingenious idea is put forward of supplying the Glasgow Corporation's tramways through 10,000 kilowatts of frequency-changing plant, a scheme which, if indulged in to any marked extent in various parts, will go a good way towards counterbalancing the contemplated saving in spare generating plant. We have heard of at least one new station within the area covered by this new report that is to be connected in parallel with an existing non-standard station through frequency changers, which are not only costly, but which also introduce appreciable loss. From time to time the suppoters of the Government's policy have put forward different claims for interconnected super-power stations. At the outset the main advantage seemed to be the great saving in the cost of coal, but as the coal used in a modern power station only costs about one-eighth of a penny per kilowatt-hour, and as electric light costs a consumer, in a rural district, from sixpence to a shilling a unit, it is evident that cheap electricity involves much more than a saving in the cost of coal. Great importance has also been attached to the possibility of working large interconnected power stations at high load factors, but the main advantage claimed in these days appears to be the saving in spare plant. On paper it seems that from this standpoint interconnection has a great deal to recommend it, although not a few contend that the saving is being exaggerated. Incidentally, inter-connection does not merely involve running lines between the stations. Boosters are usually needed at the ends of the lines, and in the case of long lines it is often necessary to employ synchronous condensers which, we trust, are being allowed for in the transmission line estimates.

It is, of course, anticipated that the average price of current in the South-East England area will be reduced to a figure considerably below that which would prevail in the absence of the scheme. But even in the unlikely event of the average price being brought down to the contemplated figure of 1·25d. per unit some users will have to pay much more than that. Within the area there are wide strips of rural and agricultural territory, where, on account of the low load density per mile, cheap distribution will be of vital importance. Distribution does not, unfortunately, come within the scope of these schemes, but since it is the Government and not the authorised undertakers that has promised the cheap and abundant supply, it is scarcely right that it should ignore this important part of the business. All the Commissioners seem to know about supplying current to farmers and others in rural parts is that overhead lines must be employed, because they are cheap. But when engineers attempt to erect these lines

to comply with the existing rules and regulations, they find that they are not cheap at all, and owing to wayleave and other difficulties, it is often quite impossible to make electrification pay. It is to be regretted that the present and previous report do not deal with the vital subject of distribution, for it is all too likely that it will entirely destroy the hope of a general cheap supply of electricity.

Cross-Checks in Boiler Testing.

The measurements necessary to determine the efficiency of a boiler plant are few in number. One has only to know the weight of fuel burnt, its calorific value, the weight of water evaporated, the temperature of the feed and the pressure and temperature of the steam produced, to calculate the efficiency of operation with all the accuracy which the reliability of the data permits. With such a test, however, the story is only half told. We know the quantity of heat generated and the quantity usefully employed in raising steam, but nothing about what has become of the difference. It is usual, therefore, to supplement the essential measurements by others which enable the various losses to be computed, in order that the whole of the heat generated by the fuel may be accounted for. Furthermore, the performances of component items of the plant, such as economiser, superheater and air heater, are generally appraised separately, so that their respective contributions to the total efficiency may be known. A record of a complete boiler test is therefore a somewhat formidable document. If the efficiency arrived at is a credible one, and is supported by a reasonable-looking heat balance account, there is not much inducement to study the columns of figures recording the direct and indirect measurements on which the results have been based.

It is often, however, extremely interesting to make a study of the kind. There are relationships between the data which depend on physical considerations and either serve as a check upon the accuracy of the tests or bring to light facts not otherwise evident. The gas and water temperatures measured at the inlet and outlet of an economiser illustrate one such relationship. It is perfectly clear that, whether an economiser is clean or dirty, efficient or inefficient, the heat units gained by the water passing through the tubes must be equal to those given up by the flue gases in passing over them, if we neglect the very small losses due to radiation, &c. Making use of this fact and employing the ordinary data of the test, we are able to compute the quantity of flue gases per pound of fuel if the specific heat of the gases is assumed, and to check the CO_2 readings or the ultimate analysis of the coal, according to the data given. A simple sum in proportion will also serve as a check upon the flue gas losses. Knowing the heat units given up by the flue gases in falling from the inlet to the outlet temperature of the economiser, it is easy to determine how many additional heat units would be given up by a further fall to atmospheric temperature. These extra heat units represent, of course, the heat carried away to waste up the chimney. It must be remembered, however, that a calculation on these lines includes only the sensible heat in the products of combustion, and takes no account of the latent heat of the water vapour produced by the hydrogen in the coal, nor of the water vapour due to the moisture in the coal. Separate allowance must be made for latent heat if the losses computed in the manner indicated are to agree with the total chimney losses based on the higher calorific value of coal as fired. The idea is, nevertheless, a suggestive one, for even if there is an air leakage in the economiser so that the quantity of gas leaving is not the same as that which enters, a knowledge of the CO_2 at entrance and exit will enable this state of affairs to be easily allowed for. If an air heater is placed beyond the economiser the temperature drop of the flue gases across the latter and the corresponding temperature rise of the air will enable the quantity of air passing to be computed. In the case of a boiler with air heater, but without economiser, this, of course, cannot be done, as there, then, is no means of knowing how much heat is given up by the flue gases for a given drop of temperature. An air heater, however, even by itself, is not devoid of interest. Whether it is worked in conjunction with an economiser or not, one can be reasonably certain that the weight of flue gases passing through it will be greater than that of the air heated. That is to be expected, not only from the fact that the flue gases must carry in themselves the weight of the combustible in the fuel, but also because in practice a considerable amount of air will generally find its way into the furnace, and so into the flue gases without passing through the air heater. Hence, taking the specific heats of air and of flue gas as sensibly equal, the temperature drop of the flue gases must be less than the temperature rise of the air. It is, nevertheless, possible to find boiler tests, published on high authority, in which the converse is shown, without any explanation of the apparent absurdity of the figures. One is left to assume a considerable leakage of flue gas into the air ducts of the heater. Besides the deductions which can be drawn from the temperature readings taken from economisers and air heaters, there are others which depend on purely chemical considerations. Ordinary air, as everybody knows, contains in round figures 21 per cent. of oxygen by volume. Hence, if a fuel containing no combustible matter, except carbon, were burnt without the production of any carbon monoxide, the sum of the percentages of carbon dioxide and free oxygen in the flue gases must always equal 21 per cent., independently of the amount of excess air present. The combustible matters in coal, other than carbon, are only hydrogen and a little sulphur. Since the sulphur is a very small percentage, and the sulphur dioxide formed by its combustion is measured as if it were CO_2 in an ordinary Orsat or other chemical apparatus, it may be neglected. If, therefore, we find, as we always do, that the sum of the carbon dioxide and free oxygen is less than 21 per cent., and if we know at the same time that no carbon monoxide is present, the missing oxygen can only be accounted for by its combination with the hydrogen of the fuel. From these considerations we are able to calculate the proportion by weight in which carbon and hydrogen were present in the fuel before burning, and so to have a check upon the chemical analysis. Furthermore, when once this carbon-hydrogen ratio has been obtained, the maximum possible CO_2 obtainable by perfect combustion with the theoretical quantity of air can be calculated, as this depends simply on the ratio of these two elements. To be able to determine the maximum possible CO_2 from a flue gas analysis only, without having recourse to a laboratory for an ultimate analysis of the coal, is frequently a convenience. This maximum possible CO_2 is a quantity which, although it represents an unattainable ideal, has more than an academic interest. When once it is known for a given fuel, it serves as a check on combustion conditions, and on flue gas analysis, for considered in conjunction with the actual CO_2 and free oxygen found at any time, it enables the amount of CO to be calculated. Again, when no CO is present, a comparison of the actual CO_2 with the maximum possible determines the amount of excess air passing through the furnace. If the percentages of CO_2 and of free oxygen are determined by an Orsat apparatus at any time when it is known that no CO is present in the flue gases, the maximum possible CO_2 for the fuel being burnt can be arrived at by dividing the actual CO_2 by unity minus 0·0475 times the percentage of free oxygen present at that time. This again checks the carbon-hydrogen ratio, and therefore the ultimate analysis of the fuel.

The difficulty with all these cross checks is that when they do not confirm figures arrived at in other ways, one does not know which to believe. The engineer is reminded once more that accuracy, in any physical measurement, is a relative term, and that none of the figures derived directly or indirectly from processes of measurement can be accepted as true except within a certain limit of error. Since any measurement, then, may be in doubt to the extent of, say, five per cent. or one per cent. or possibly only a thousandth of one per cent., according to the nature of the case, it is of importance to know what is the margin of error which has to be allowed for in various kinds of commercial measurements carefully made. As we have said before, it would be hardly possible to render a greater service to the art of boiler testing, than to determine by statistical methods the reliance that can be placed on coal analyses and calorific values. The work may not be so spectacular as the microscopic examination of coals by transmitted light, or some other kinds of "research" now being subsidised by public money, but it would at least have the advantage of being of immediate practical value to engineers.

Locomotive Research.

On another page a correspondent discusses the presidential address which Mr. H. N. Gresley delivered to the Institution of Locomotive Engineers a few days ago. With much that our correspondent says we are in hearty agreement, but on other points we cannot see eye to eye with him. In his address Mr. Gresley suggested that the State should provide a locomotive testing plant on which complete investigations of engines could be carried out by independent workers. The plant would, of course, be available to all who paid the necessary fee, just as the Research Tank at Teddington is available to shipbuilders and designers. There are very few good locomotive testing plants in the world. The most notable of them is that at Altoona in the United States. On it many valuable researches have been made, and whilst it must always be recognised that static researches into locomotive performace differ from actual road trials, yet there can be little doubt of the comparative value that can be estimated on a plant of the kind between different designs of engine. There is, of course, in England a plant at Swindon belonging to the Great Western Railway, but it has well-known limitations and is certainly far behind the Altoona plant in completeness. We should, indeed, welcome the existence of an apparatus of the kind in England, for we are confident that it would do something to encourage locomotive research amongst both our railway and our private builders, but we must admit to some doubt that such a plant could be adequately handled by the State. We incline rather to the view that it should be a private enterprise, and that it should not be placed under the painful obligation of justifying its existence to the Treasury. It is not easy to make even a rough guess at the cost of the necessary equipment, but we have little doubt that a good start could be made for an expenditure of £40,000 to £50,000, and we seriously suggest to the four railway groups that they should between them put up a sufficient sum to purchase a site—the position of which would have to be carefully selected—and the necessary plant. Once in existence the plant might be self-supporting, as naturally a fee would be charged for all experiments carried out. The plant should, we need scarcely add, be not only available to the four companies themselves, but to any private builders who might desire to make use of it. Finally, when we recall that the great Tank at Teddington was given through the private beneficence of Sir Alfred Yarrow, and when we think of the great sums that have been devoted in the same manner by private individuals to research in other directions, we venture to suggest that in locomotive development, a subject so proper to Great Britain, which was the home of locomotives, some rich man might find an opportunity for benefiting his country in a high degree.

The Amsterdam Congress for Testing Materials.

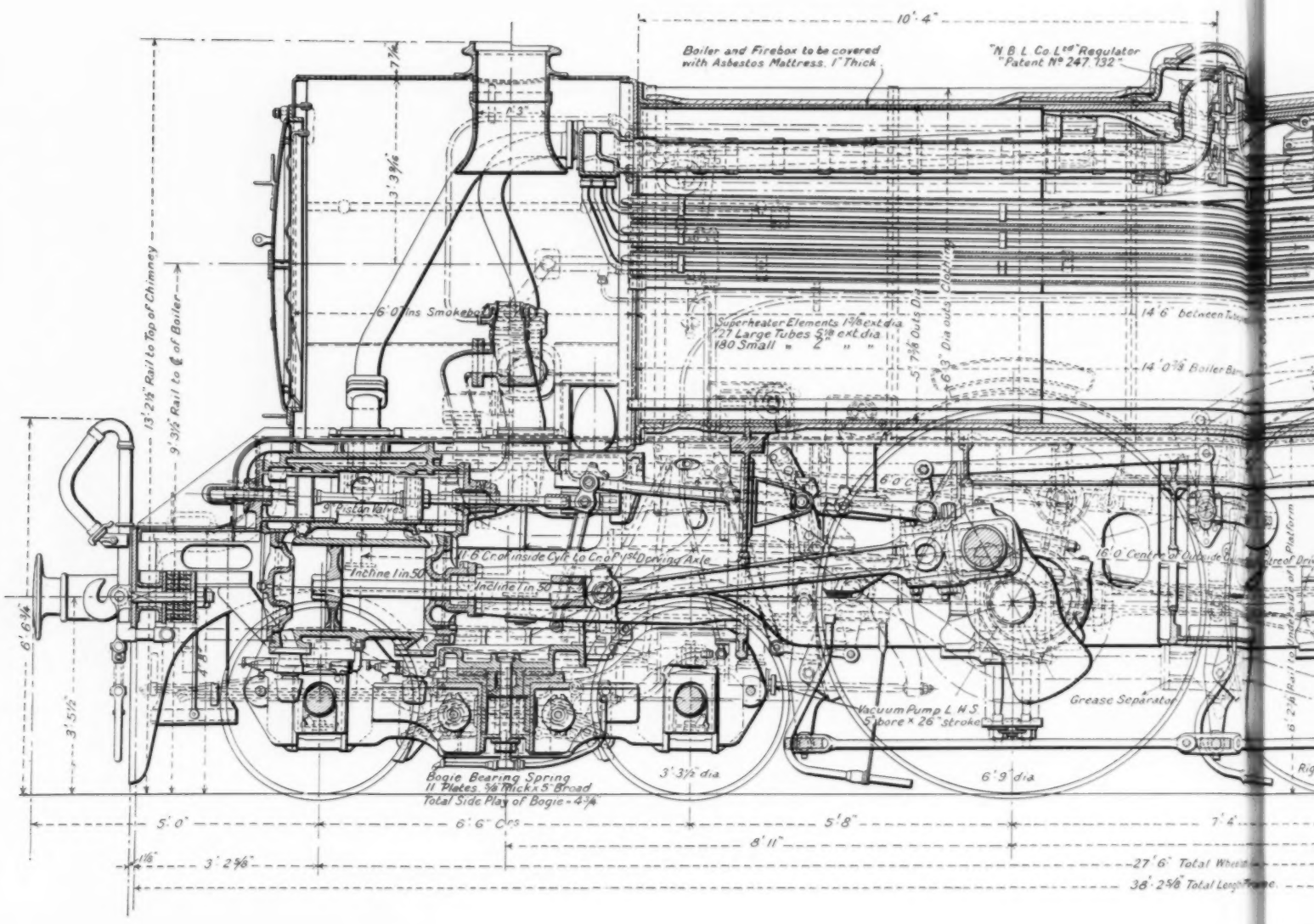
An "International Congress for Testing Materials" was held at Amsterdam from September 12th to 17th inclusive, and undeniably achieved a great measure of success. It will be remembered that prior to the Great War an active International Association for the Testing of Materials was in existence, with a permanent secretariat situated at Vienna, and comprising an elaborate organisation whose object was not only to arrange International Congresses at three-year intervals, but also to maintain a more or less continuous international collaboration by means of a large number of international "committees" or "commissions," appointed to deal with a series of specific questions. As a result of the war this organisation disappeared, but even before the war some serious internal difficulties had manifested themselves, owing to the prominence which had been given to questions of international standard specifications at the New York Congress of 1912.

The Congress which has just been held at Amsterdam thus represents to some extent an attempt to revive, at least, the series of International Congresses, if not the old Association. It was arranged mainly by an organising committee consisting of Dutch and Swiss members interested in the revival of international co-operation in this important branch of technology. A preliminary gathering was held in Zürich a year earlier, and there the definite decision was arrived at to summon a Congress to Amsterdam this year. The result has fully justified the efforts of the organising committee, which must have devoted a large amount of time and energy to the matter. It succeeded in assembling at Amsterdam over 500 participants, among them, most, if not all, of the leading men connected with the subject, and these presented for discussion a formidable array of papers and "reports." While these varied widely in quality, they certainly included some important contributions and led in some cases to animated and fruitful discussions, which were, however, always most friendly in tone. In fact, the general impression afforded by the Congress was one of international amity and co-operation, with—in general—an indication that

MICH.

L. M. AND S. RAILWAY—THREE-CYLINDER EX

BUILT TO THE DESIGNS OF SIR HENRY FOWLER, K.B.E. AT THE


10' 4"
Boiler and Firebox to be covered with Asbestos Mattress, 1" Thick
"N B L Co Ltd" Regulator "Patent No 247 132"
13' 2½" Rail to Top of Chimney
9' 3½" Rail to ℄ of Boiler
7'½"
3' 3½"
6' 0" ins Smokebox
Superheater Elements 1⅜ ext dia
27 Large Tubes 5⅛ ext dia
180 Small " 2" " "
5' 7⅛" Outs Dia
6' 3" Dia outs Cladding
14' 6" between Tube
14' 0⅛" Boiler Bar
6' 0" Crs
9" Piston Valves
Inclined 1 in 50
11' 6" Crs Inside Cyls to Crs of Pistons
Driving Axle
Inclined 1 in 50
16' 0" Centres
Grease Separator
Vacuum Pump L M S
5" bore × 26" Stroke
6' 6¾"
3' 5½"
Bogie Bearing Spring
11 Plates ⅜" Thick × 5" Broad
Total Side Play of Bogie = 4¾"
3' 3½" dia
6' 9" dia
5' 0"
6' 6" Crs
5' 8"
7' 4"
8' 11"
27' 6" Total Wheel
1⅛"
3' 2⅝"
38' 2⅝" Total Length
U.K. Metallic Packing
11' 3" Crs of Outside Conn Rods
8' 6" Buffer Beam
5' 6½" Crs of Buffers
8' 9" Crs of Conn Rods
4' 5½" bet Tyres
8' 7" over Platform
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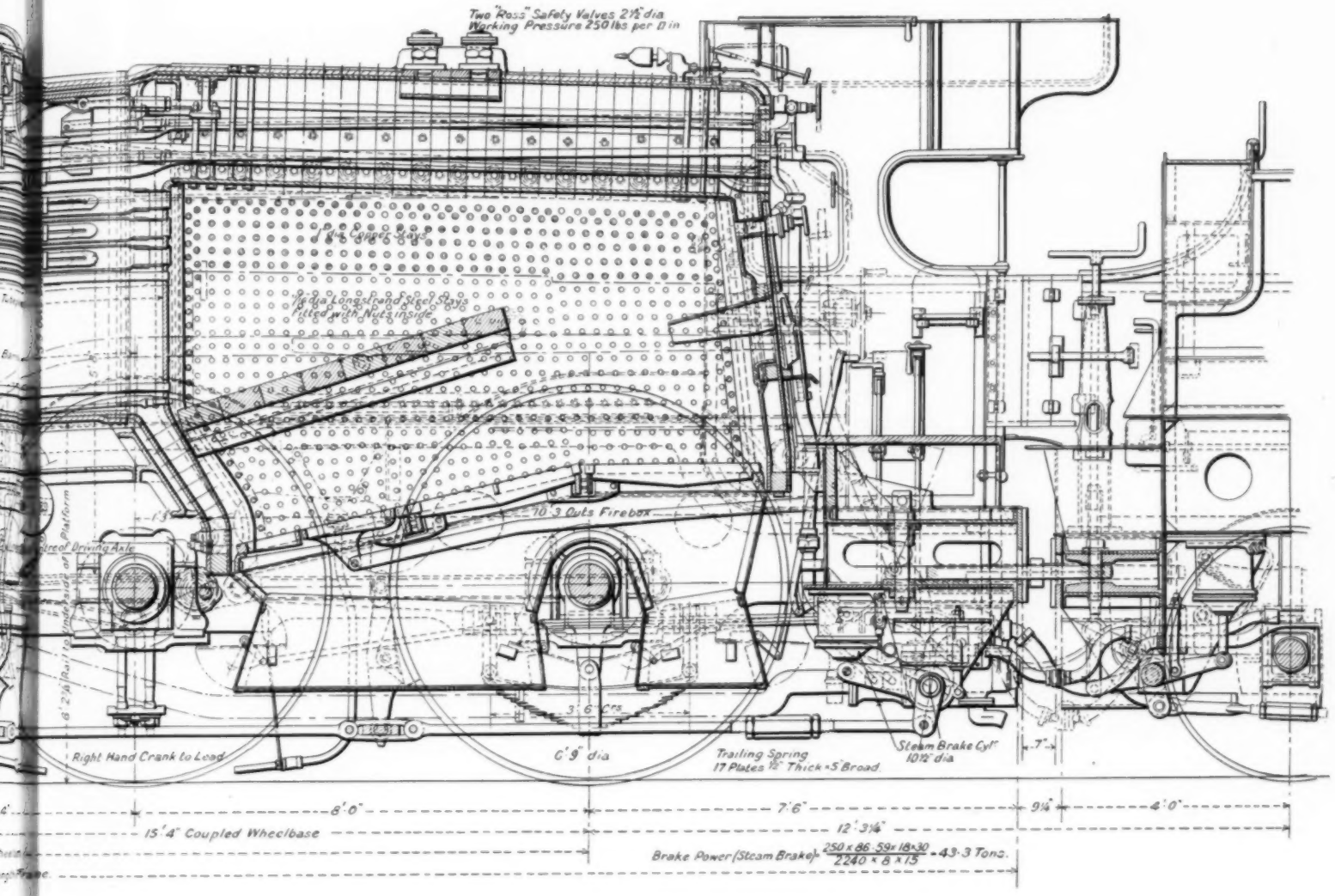
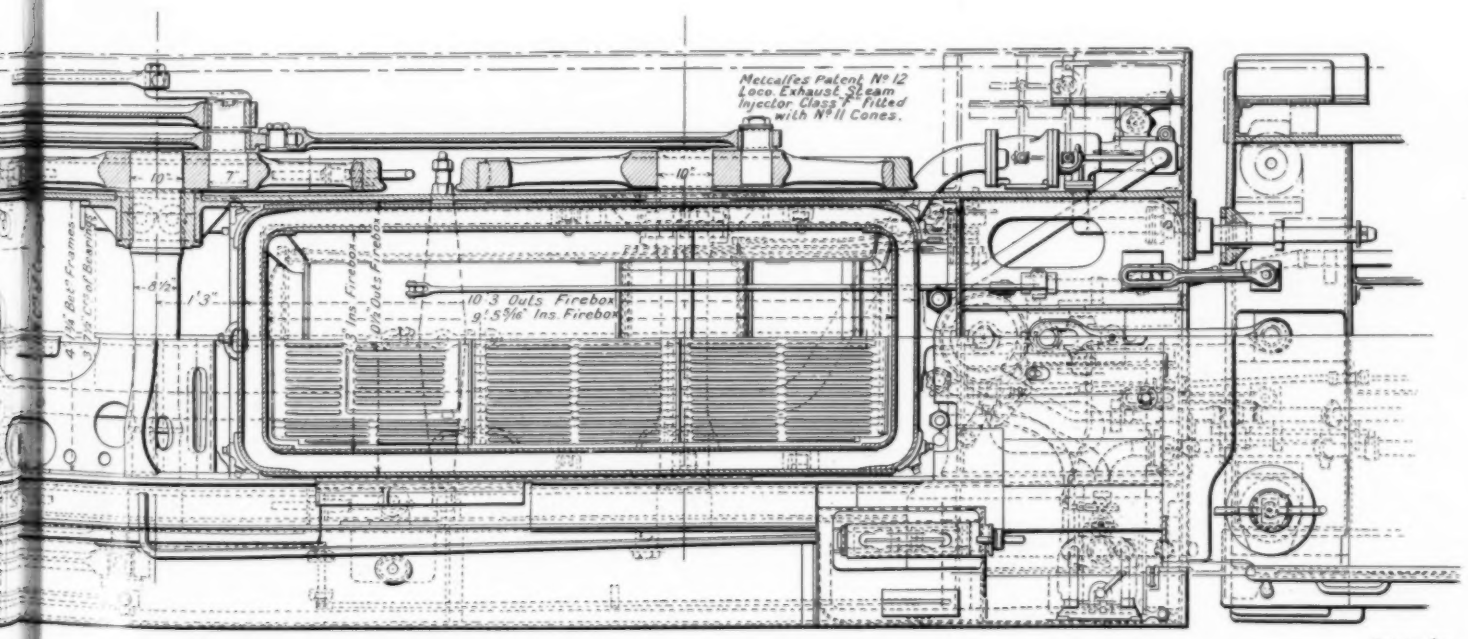
EXPRESS LOCOMOTIVE "ROYAL SCOT"

THE NORTH BRITISH LOCOMOTIVE COMPANY, LTD., GLASGOW


Two "Ross" Safety Valves 2½" dia.
Working Pressure 250 lbs per D in
Fitted with Nuts inside
70 3 Outs Firebox
Right Hand Crank to Lead
6'9" dia
Trailing Spring
17 Plates ½" Thick × 5" Broad.
Steam Brake Cyl.
10½" dia
8'0"
7'6"
9¼
4'0"
15'4" Coupled Wheelbase
12'3¼"
Brake Power (Steam Brake) = 250 × 86·59 × 18·30 / 2240 × 8 × 15 = 43·3 Tons.



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during the years in which international co-operation has been suspended, workers in different countries have arrived at views which, if not identical, are at least much less divergent than might have been anticipated. In several instances similar methods and ideas had been arrived at independently, and international agreement seems less impossible than it did fifteen years ago. This happy state of affairs, however, is to some extent the result of the total exclusion of the whole subject of international standard specifications from the work of the Congress. The British view that such questions are best left to special bodies having a more suitable organisation, was widely shared, and it is satisfactory to find that this entire subject has been specifically excluded from the future work of the permanent organisation which was created at Amsterdam, mainly for the purpose of arranging further International Congresses from time to time.

In this connection, the question of reviving the old International Association was raised, and strongly pressed from many quarters; after much discussion the matter was finally left to a small sub-committee of the Delegates' Meeting, and a very simple skeleton constitution for a permanent body, to be called "The New International Association for Testing Materials," was drawn up, and finally adopted unanimously by the delegates of seventeen nations. This "New" Association, however, is entirely different from the old one, and shares with it only the task of organising International Congresses at intervals of not less than three or more than five years. There are to be, however, no permanent secretariat nor—for the present, at all events—any committees or commissions, except a single "Permanent Committee" consisting of one representative of each country having a membership in the New Association of not less than twenty. These representatives are to be appointed by the Associations for the Testing of Materials which exist in most countries; to meet the British case, where no such association or society exists, appointment by "some equivalent organisation" is provided for, and a British Committee, consisting of representatives of the various institutions and societies concerned with the testing of materials will have to be formed for the purpose of securing British representation on the Permanent Committee of the New Association and of securing an adequate membership, as well as satisfactory national representation, both by the attendance of members and the presentation of papers at future Congresses. At Amsterdam the British attendance was unfortunately small, and the number of papers from this country was very small compared with the contributions more particularly from America, Germany and France. We were also without officially appointed delegates at the Delegates' Meetings, but the Amsterdam Organising Committee had invited Sir Henry Fowler, K.B.E., and Dr. W. Rosenhain to attend these meetings as unofficial delegates, who were thus enabled to represent British views in the organisation of the New Association very effectively.

It is quite impossible to give in a reasonable space any full or systematic account of the technical work of the Congress which sat in three sections, dealing respectively with (*a*) Metals, (*b*) Cement and Concrete, and (*c*) Miscellaneous Materials, for four days, starting at 9 a.m and frequently continuing their work until 4 p.m. The chief criticism of the Congress, indeed, is that far too much matter was presented, and too many subjects touched upon, so that too little time was left for discussion of the really important matters, either in the public meetings of the sections or in private conversations among members. There was, of course, the inevitable language difficulty, and very little interpreting was done. In one way this was much to the good, since interpreting is often very unsatisfactory and occupies a great deal of time. On the other hand, there was at Amsterdam a tendency for members to come only to hear those papers which were read in their own language or in one to which they were accustomed. Actually, English and German predominated. If, at future Congresses, it should prove possible to devote time to only a few important questions and to discuss those fully, and to have at least the more important opening papers printed and circulated in advance in three languages, a much happier state of affairs would result. This is the kind of organising work, however, for which a permanent Committee is necessary, and the Organising Committee at Amsterdam had no international organisation behind it.

Four principal addresses were delivered to sessions of the full Congress (as distinct from the Sections) by one representative each of America, France, Germany and England. The American, Mr. T. D. Lynch, of the Westinghouse Company of Pittsburgh, took as his subject "Materials Testing as a Stimulus to Research." He showed how in a variety of ways the data as well as the problems of testing give rise to new problems both in regard to the design of structures and machines and to the improvement of materials and of our knowledge of them. The science and art of testing materials, in fact, constitutes at many points the closest contact between laboratory methods and commercial practice. The French address, by Monsieur Mesnager—one of those who had played a very important part in the work of the earlier series of Congresses—dealt with the problem of the "Fracture of Solids," treating it from the viewpoint of the theory of elasticity rather than from that of the crystalline or atomic structure. Even ignoring this finer structure, however, it was pointed out that bodies cannot be regarded as strictly homogeneous or isotropic, and attention was called particularly to the effect of inhomogeneity on the mode of fracture under compression. Theoretically, a perfectly homogeneous body should withstand compression to an indefinite extent, but experiment shows that actual materials break along lines or surfaces parallel to the direction of the applied pressure. The more usual "double cone" type of compression fracture is shown to be due to the friction at the end surfaces where the pressure is applied, and when this friction is eliminated fracture into vertical strips occurs. This mode of fracture is ascribed to the presence in the body of discontinuities, such—for example—as scattered air-bubbles in a block of glass. The effect of the presence of comparatively few and large cavities of this sort was discussed more fully, and it was suggested by Mr. Mesnager that the inhomogeneity existing in ordinary materials produces very similar effects. The hypothesis of Mohr and the experiments of Karman were thus correlated in an interesting manner, and it was suggested that a basis for a more reasonable theory of the strength of materials might be arrived at from these considerations.

Professor Koerber, the Director of the Kaiser Wilhelm Institute for Iron and Steel Research at Düsseldorf, gave the German address, in which he dealt with the problem of the "Yield Point." The mode of yield or flow of different types of iron and steel was fully discussed, but the matter cannot be summarised without detailed reference to diagrams, which will not be available until the paper appears in print. The English address, by Dr. W. Rosenhain, dealt with the "Plastic Deformation and Fracture of Metals," but treated the subject in relation to the crystalline structure of the metal and the atomic structure of the crystals themselves. As we propose to reproduce this paper in abstract in our columns no fuller reference to it need be made here.

For these four principal addresses ample time was allotted; on the other hand, the authors of other papers were obliged to confine themselves to the presentation of brief abstracts, and these had in many instances to be given by colleagues in the absence of the author. As the papers were not available in print, discussion in such circumstances was difficult. Nevertheless some interesting questions were raised. Thus a good deal of attention was devoted to the notched-bar impact test, which has established itself firmly in most countries as a test, primarily of the proper treatment—both thermal and mechanical—of a given sample of material of a certain type. The difficulties of the test were generally admitted, and its usefulness and importance was generally recognised, but it was acknowledged that it did not necessarily furnish a criterion of value as between materials of widely different types. It was, however, felt that since the results could not be transferred with certainty from one size of test-piece to another, the adoption of a standard test-piece and of a standard notch was particularly desirable. A wide range of test-piece sizes and types of notch was mentioned, but it is interesting to note that the Germans, like ourselves, have largely adopted the V-notch with a very small radius of curvature at the point of the V. The difficulties in the way of accurately reproducing such a notch have disappeared with the introduction of the projection method of gauging both cutters and notches, and the greater sensitiveness of the sharp V-notch is appreciated.

Another matter of wide importance which was discussed at some length was the problem of abrasion testing. This has received much attention abroad during recent years, and extensive claims were put forward by Spindler for the testing machine of his design. He claimed that over eleven years' experience of the wear of steel rails in Austria had shown excellent correlation with the results obtained with the Spindler machine. On the other hand, equally strong claims were made for other types of abrasion testing machines particularly for those in which rolling friction with slip is allowed to produce surface hardening as well as abrasion. In this connection it was pleasing to find that Dr. Füchsl, of the German Railway Testing Department, gave full credit to Mr. E. H. Saniter, of Rotherham, for originating the idea. It was an interesting coincidence that Mr. Saniter himself was one of the English representatives present at the Congress.

American authors presented a series of interesting papers, among which a further account of his researches on "Corrosion Fatigue," by Mr. J. D. McAdam, jun., a summary of the existing situation in regard to fatigue testing by Professor Moore, of the University of Illinois; an account of magnetic testing methods for detecting defects in steel, by Mr. De Forrest; and an account of recent micrographic work at very high magnifications, by Mr. Lucas, may be mentioned. The paper on magnetic testing methods was cleverly illustrated by a cinematograph film showing first the process of passing the steel through the testing instrument and then illustrating what the operator saw in the cathode-ray oscillograph. Mr. Lucas' very highly magnified photo-micrographs commanded universal admiration and respect, but it is not quite certain whether their clearness and beauty is not due at least as much to the very great care and skill employed in the preparation of the surfaces of the specimens as to the use of exceedingly high magnifications. The resolution of the structure of Troostite in tempered steel, showing that it is of the nature of a spherulitic crystallisation, is of considerable interest. So also is the degree of success achieved by Mr. Lucas in the use of the ultra-violet rays in the production of high-power photo-micrographs. In this work he is favoured by the use of special apparatus constructed for him by Messrs. Zeiss, and further results of interest may be anticipated.

A further wide range of subjects relating to Concrete, Cement and Building Stones was discussed in Section B of the Congress. Much attention was naturally devoted to the various methods of testing cement and concrete, but, in addition, some subjects of special interest were considered. Among these may be mentioned the question of the importance of the use of high-grade steel in ferro-concrete construction, as it is pointed out that in the majority of existing types of structure failure must set in by rupture of the steel long before crushing of the concrete occurs, even under bending stresses. An increase in the strength of the concrete employed is therefore useless unless either a higher grade of steel is used or a larger proportion of reinforcement is adopted. This conclusion was reached by different methods both by Dr. Emperger, of Vienna, and Mr. R. Maillart, of Geneva.

An interesting investigation of "Ciment Fondu"—aluminous or bauxite cement—was presented by the veteran, Monsieur Henri LeChatelier, who was not, however, present in person, and Monsieur Duhameaux, of Paris. The results show that this cement is much more complex than ordinary Portland cement, so that while the latter contains only one active hydraulic substance, the former contains at least two and the relative proportions for a cement of given chemical composition will vary according to the rate at which it has been cooled. The setting and other properties may therefore differ considerably. Another interesting subject was that of "Cellular Cement," or concrete, described as the invention of a Danish engineer, E. C. Bayer, by E. V. Meijer, of Copenhagen. Produced by introducing into liquid cement a foam of high tenacity, the product is very light, and has excellent thermal insulating properties. The strength is, of course, reduced, but is still sufficient for many purposes. Cellular plaster can also be made in the same way.

In this section (B) of the Congress considerable attention was also paid to the properties and testing of refractories. The value of the cone or "squatting" test is now somewhat discounted, and chief importance appears to attach to the determination of the temperature of softening under load and of the thermal expansion and conductivity. The thermal expansion is particularly valuable as indicative of the nature and treatment of silica bricks.

Section C of the Congress, devoted to "Miscellaneous Materials," laboured under the difficulty of having to deal with too widely different subjects, ranging from lubricating and transformer oil to fuel, timber, rubber and anti-corrosive paints. Much interesting matter was presented, but it is difficult to select any individual questions for mention here. The publication of the Congress volume will not, it is to be hoped, be unduly delayed, so that those interested may be able to study the numerous papers in full.

Beyond the full and sectional meetings of the Congress a programme of excursions and entertainments was provided, including an interesting steamer excursion down the North Sea Canal to inspect the great works for the new sea locks at Ymuiden, which will make the port of Amsterdam accessible to the largest ocean liners. Further, on the afternoon and evening of the last day of the Congress an excursion was made to The Hague and Scheveningen, ending with a banquet in which the greater number of those attending the Congress took part. On the previous evening the Organising Committee had already entertained the delegates of the seventeen countries represented at dinner, at the conclusion of which a brief formal meeting of the delegates was held for the purpose of adopting the draft constitution of the "New Association." Complete unanimity was arrived at, including the decision to hold the next Congress at Zürich and the appointment as temporary honorary secretary of Professor Ros, of the Technical High School at Zürich—one of those who had done much towards the organisation of the present Congress. He had shared with the Dutch members, Messrs. M. E. H. Tjaden, P. F. van der Wallen, and Dr. E. B. Wolff, much of the preliminary work. They had received much substantial support from prominent Dutch engineers and industrialists, and also from the Netherlands Government and the city of Amsterdam. Upon the result they are to be entirely congratulated.

Apart from the meetings and discussions of the Congress, there was much friendly personal discussion in an atmosphere tending to develop international friendship and understanding. From our point of view, the fact that only seven British members attended the Congress was regrettable, and it is most earnestly to be desired that our technical and scientific men will take a more active part in future Congresses of this sort.

New Source of Water Supply for Newport.

On Thursday, September 29th, the works in connection with the new source of water supply from the Talybont watershed, which the Corporation of Newport, Mon., has recently acquired, were formally put into service by Alderman Thomas Parry, the Chairman of the Waterworks Committee.

Before proceeding to describe the new undertaking it will, perhaps, be of interest to review briefly the history of Newport's waterworks undertakings. The Corporation acquired its original works from the Newport Waterworks Company in the year 1888 at a cost of £278,000. The works comprised two reservoirs at Ynys-y-fro, with a combined capacity of 120,000,000 gallons, and a third reservoir at Pant-yr-eos, which was capable of impounding 145,000,000 gallons. The total storage capacity was therefore 265,000,000 gallons. At that time the average daily consumption was less than 1¼ million gallons, while the average daily *per capita* consumption was some 20 gallons.

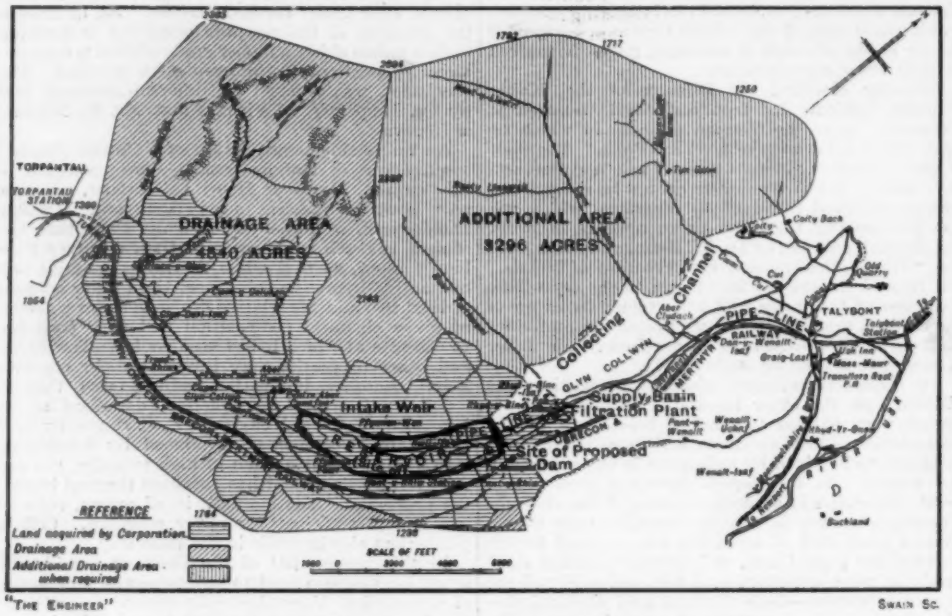
With the undertaking there were also transferred to the Corporation the powers which the company had granted to it by Parliament in 1887 to construct new works at Wentwood. Those powers were not acted upon for another six years, but in 1894 the Corporation began the construction of the Wentwood Reservoir. A good many difficulties were met with during the progress of this work. They were, however, successfully overcome, though the new reservoir was not finally brought into use until 1904. The Wentwood scheme cost upwards of £400,000, but the additional reservoir, known as the Llanvaches, added 410,000,000 gallons to the Corporation's storage capacity, bringing the total up to 675,000,000.

By the year 1909 the average daily consumption had risen to 2½ million gallons, and the then Chairman of Committee—Alderman Parry, who continues to fill that position—reported that, if the population of Newport continued to increase at a rate corresponding to that of preceding years, a larger supply of water would be required within ten years. An examination of possible sources of additional supply was then made, and it was at first suggested that a reservoir might be constructed in the Henllys Valley. On investigation, however, it was considered that the maximum quantity which it would be possible to derive from that source would be insufficient to meet the probable demand. Other possible sources were then discussed, the principal being: (*a*) Cwm Du, near Talgarth; (*b*) the Grwyne Fechan; (*c*) the Honddu, above Llanthony; and (*d*) the Caerfanell at Talybont. Of these it was found that the last-named possessed many advantages over the others, and the then Water Engineer, Mr. H. Tremelling, was instructed to prepare, in conjunction with Mr. Francis J. Jupp, of Newport, a joint report upon the subject of obtaining a supply from Talybont. Later Messrs. G. H. Hill and Sons, of Westminster, were also instructed to submit a report on the scheme and, in 1918, acting on their advice, the Council decided to present to Parliament a Bill seeking powers to construct a large reservoir in the Caerfanell Valley. The proposal, however, met with considerable opposition and the promotion of the Bill was negatived at the statutory meeting and afterwards by a poll of the town.

It was then suggested that additional supplies should either be purchased from Merthyr, the Taf Fechan scheme of which was then being carried out, or from the Severn Tunnel or from the river Usk. In 1919 Mr. W. A. Tait, of Edinburgh, was instructed to report on these suggestions, and he decided against them all, giving it as his opinion that the Talybont scheme was the best for Newport to adopt, though the works that he suggested were not so extensive as those which had been embodied in the Bill that was thrown out.

As a result the Council decided to reintroduce the Talybont scheme, and although the proposal was negatived at the statutory meeting, the subsequent poll of the ratepayers was in its favour.

Two somewhat unusual, but eminently useful, clauses were, on the suggestion of the Chairman of the Waterworks Committee, embodied in the Bill, and received parliamentary sanction. The first authorised the Corporation to postpone for twelve years from the passing of the Act the construction of the large reservoir portion of the scheme, since it was considered that for many years the needs of Newport could be adequately met by taking water direct from the stream. As a consequence it will not be incumbent on the Corporation to begin the building of the dam, at any rate, until July, 1932. The other clause increased the term for the repayment of the loan for



THE TALYBONT WATERSHED, SHOWING POSITIONS OF NEW WORKS

the intake, and that it was unlikely that more than 1¼ million gallons a day on the average of a drought would be realised, and that the quantity might be even less. It was ascertained on investigation that the water was lost into the drift a long way above the intake.

The question then arose as to whether the works should remain as they were or whether the additional length of barrier should be constructed, in which case there would have been available, during the severest drought, about 2¾ million gallons per day. It was eventually decided that since, with the quantity of water obtainable from the pre-existing sources, the total volume available would be in the neighbourhood of 4¼ million gallons per day, and since that volume would be sufficient to cover the needs of the town for some time to come, the construction of the additional length of barrier, which would cost some £8000, should be postponed.

After being drawn from the river the water passes down a 25in. pipe to a filtration plant which we describe below, and which is situated 1¼ miles below the temporary intake weir, where it will be treated and filtered. After being filtered the water will flow to a supply basin a short distance away, where it will enter the piping by which it will be conveyed to Newport. The distance between the intake weir and the centre of Newport is about 34½ miles. The first section of the piping, which begins at the supply basin and which is 25 miles in length, terminates at a break-pressure tank near Pontypool-road Station. At present it consists of one line of cast iron piping 25in. in diameter. On this section there are fifteen 21in. stop valves, four self-closing stop valves, five reflux valves, fifty-four 6in. scour valves, and ninety-four air valves. In addition, the inlet is controlled by a flap valve and the outlet by a ball valve.

The next section of piping ends at the service reservoir at Llantarnam. It is about 5½ miles in length and it at present consists of one line of cast iron piping 19in. in diameter. On this section there are three 21in. stop valves, one self-closing stop valve, twelve 6in. scour valves, and sixteen air valves.

The complete scheme provides, as has been explained, for two covered service reservoirs at Llantarnam, each having a capacity of 5 million gallons, but only one has been constructed at present to serve the first line of piping. The walls and floor are constructed of mass concrete and the roof, and the

ROUTE OF PIPE LINE

columns to support it, of reinforced concrete. The reservoir is divided into two parts by a cross wall, to facilitate cleaning without it being necessary to shut off the supply. The piping from the reservoir, which joins the town's distributing system some 2 miles away, at present consists of one line of cast iron piping, part of which is 25in. in diameter and part 27in. It is furnished with a pressure reducing valve of an important character, for the purpose of limiting the pressure that can come upon the piping in the town.

A considerable number of bridges and subways had to be constructed to carry the piping over or under streams, railways, &c. At all the special works of that character and at all the valve houses provision has been made for the second line of piping. The water is gauged over a sill weir in the filter house, and again by means of a recording Venturi meter where it enters the service reservoir. The weight of cast iron piping employed in the aqueduct is some 21,600 tons. About half of it was manufactured by the Stanton Ironworks Company, the other half being supplied by Jordans and Spittle, of Newport. All the valves and the miscellaneous ironwork were supplied by Glenfield and Kennedy, of Kilmarnock. The general work of construction was carried out by the

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MACHINE FOR DEALING WITH LOCOMOTIVE CYLINDERS

H. W. KEARNS AND CO., LTD., BROADHEATH, MANCHESTER, ENGINEERS

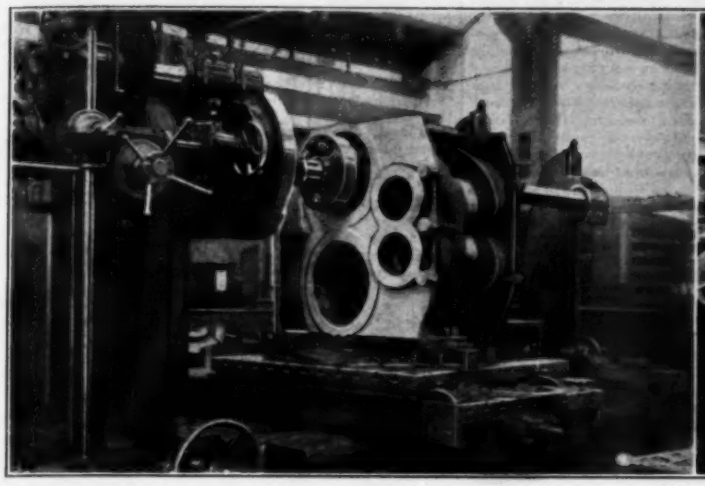


FIG. 1—BORING CYLINDER BARREL

FIG. 2—BORING PISTON VALVE CHAMBER

FIG. 3—DRILLING, TAPPING AND STUDDING

FIG. 4—MILLING FACE OF CASTING

Unit Construction Company, while the filtration plant, which we are about to describe, was designed and constructed by the Paterson Engineering Company, Ltd., of London.

The filtration plant has been arranged so that a duplicate set can be constructed in the future when it becomes necessary to utilise all the water which the scheme will provide. The capacity of the first installation has been fixed at 5,000,000 gallons per day because the installation will have to deal with a maximum abstraction from the river at that rate. The average will be smaller.

The water, which in times of flood may be heavily laden with marly silt, at present passes directly to the filtration plant without preliminary settlement. When the reservoir is built the working conditions will, of course, be greatly improved, because the flood waters will have undergone a process of prolonged settlement before reaching the filtration plant. The raw water first of all passes over a rectangular bronze weir, where the flow is measured and where the fluctuations in the level of the water automatically control the supply of the chemical reagents necessary to effect the purification of the water. The reagents used are sulphate of alumina to effect decolourisation, and lime to neutralise any corrosive tendency there may be in this upland water. The method of treatment and the apparatus employed are so similar to those we described fully in connection with the recently completed Taf Fechan undertaking,* which were also supplied by the Paterson Company, that we need not describe them in detail in the present instance. A chloronome administers a minute trace of chlorine to the filtered water to ensure the highest standard of purity even at times of excessive flood.

As, under no circumstances, must the impurities abstracted from the water cause pollution to the main stream, a very complete sludge disposal plant has been provided. All the washings from the filters and the sludge from the coagulating and precipitating tanks are discharged into settling tanks arranged in duplicate, where they are allowed to remain quiescent for a period to permit settlement of the heavier impurities. The supernatant water is pumped back to the coagulating and precipitating tanks and, after passing through the filters, is recovered as filtered water. The sludge tanks have shelving bottoms, so that they are self-cleansing, the inrush of water flushing the settled impurities into deeper hopper-bottomed tanks alongside a press house. The concentrated sludge is pumped into filter presses and the solid cakes obtained are dropped into bogie tanks for disposal.

In a brochure, which was prepared for distribution at the opening ceremony and from which the particulars contained in the foregoing have been obtained, the fact is emphasised that the works as they now exist are only intended to give a temporary supply of water to Newport, *i.e.*, until the expiration of the period within which the Corporation is empowered to postpone the commencement of the large reservoir. That, as has been said above, is in the year 1932. As a matter of fact the Corporation Water Department has very little doubt that the supply afforded by the present works will carry the town beyond that time. In that case it would be necessary to apply to the Ministry of Health for a further postponement. In support of this view it is pointed out that by a comparatively small expenditure in extending the piling across the flat land and thus increasing the length of the barrier weir an additional supply of water can be brought to the existing intake. The cost of the works to date has been about £600,000.

In conclusion, we may say that Mr. W. E. Lloyd, M. Inst. C.E., is the Borough Engineer and Water Engineer. The Resident Engineer was Mr. P. S. Spencer, Assoc. M. Inst. C.E., and the Deputy Resident Engineer Mr. H. Kerr, Assoc. M. Inst. C.E.

* See THE ENGINEER, August 5th, 1927.

Machining Locomotive Cylinders.

SEVERAL machining demonstrations on locomotive cylinders of the usual twin type have recently been given by H. W. Kearns and Co., Ltd., of Broadheath, near Manchester. The method is unusual, inasmuch as locomotive cylinders are generally machined on various types of tools, each dealing with a particular operation or series of operations, whereas in the present instance the whole of the operations were performed on one machine, thus saving the loss of time usually incurred through the transference of the casting from one machine tool to another. The machine tool used was a No. 5 size Universal surfacing, boring, milling, drilling and tapping machine, combining a travelling spindle 5in. diameter with automatic facing. The machine is fully universal, and provides a wide selection of speeds and feeds. When dealing with cylinders of the type indicated practically every function of the machine is utilised.

The illustrations—reproduced with Mr. H. N. Gresley's permission—show certain of the principal operations on a pair of cylinders supplied by the Darlington works of the London and North-Eastern Railway Company, and as used on that company's class "W" locomotives. This pair of cylinders was completely machined, including all operations, at two settings, and 80 per cent. of the work was actually performed at one setting. Figs. 1, 2 and 3 show the cylinders at the first setting, and Fig. 4 shows the cylinders at their second setting. Fig. 1 shows the machine operating on one of the cylinder barrels. The diameter is 19in. and the actual length of the bore is 32in. and the stroke 26in. The bore was machined by means of a boring head carrying three tools for roughing operations, and one adjustable tool for the finishing cut. A special feature is the use of two boring stays set in tandem—as shown in the illustrations. These stays are set a short distance apart, and by this arrangement a very high degree of accuracy as to parallelism and roundness was obtained. Fig. 2 shows a similar operation on a piston valve chamber. Fig. 3 shows the processes of drilling, tapping and studding. For these operations the travelling spindle is revolved independently of the facing chuck, and at the relatively high speeds necessary for drilling operations. The spindle is, of course, provided with a reversing motion. Fig. 4 shows one of the milling operations. It will be noticed that the milling cutter is carried in the travelling spindle, and it will also be noted that the spindle is provided with additional support by an outer bearing which is mounted on the facing slide of the machine.

The whole of the operations were carried out under the observation of the railway company's officials. The detailed times were as under:—

	Hrs.	mins.
(1) Total setting time	3	10
(2) Boring cylinders	13	55
(3) Boring valve chambers	8	10
(4) Facing valve chambers	3	30
(5) Various milling and facing operations ..	12	55
(6) Drilling, tapping and studding operations	13	45

Similar demonstrations have been carried out on cylinders supplied by the locomotive works at Derby, Crewe and Gorton, and by the Dutch State Railways.

A FACTORY for the production of caustic soda is to be put up on the banks of the Duck River, Camellia New South Wales, by the Mount Lyell Mining and Railway Company.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE SUKKUR BARRAGE PROJECT.

Sir,—Statements of the type made in Mr. Woods' half-dozen columns of December 24th, 1926,* will not carry much weight. Some have been dealt with by Mr. P. Claxton, an engineer who knows and understands the Indus. Mr. Woods states that K is a stable site because the western bank is stable and the river has a western tendency. He does not know that this is the average result of a number of annual swings this way and that. He thinks that the river always hugs the western bank. Mr. Claxton shows† that even the western bank is not stable and also—as regards the chance of an avulsion—the radical difference between a case where the river is free and one in which there is an embankment across the line of a possible avulsion.

As to the idea of doing without a barrage, Mr. Woods thinks that I was never on perennial canals—actually ten years of my service was on them—and that the project engineers, too, are deficient in "perennial canal science." He thinks the canal head might be shifted upstream to a narrow place. He "definitely stated that the site might be anywhere in the 3-mile stretch of gorge." Every furlong the site is moved upstream brings it to more silt-laden water. At any narrow place the silt is churned up and the site impossible.

Heading-up at Barrage.—Mr. Woods—using wrong coefficients and wrong values of V_a—makes the afflux 4ft. and then 2·25ft. Actually $V_a = \frac{Q}{A} = 13{\cdot}2$ft. per second. There is no crest, but a straight run through and very large openings and bell mouths. The American engineer Houk elucidated this case ten years ago.‡ The project engineers made the net fall—allowing for the rise where the pier tapers—1ft. I make it 1·34ft. An experiment with a model would be desirable. Possibly the project engineers tried this, but in the absence of reports 1·34ft. can be accepted. Mr. Woods reverts later to a fall of "4ft.," then to "3ft. or 4ft.," and finally—in a diagram—to 2ft.

Avulsions.—In my article of August 20th, 1926, besides the statements repeated briefly below, some of minor importance were made. Mr. Woods mixes them all up and confuses the issues. Avulsions are common where a river forms pronounced loops. The avulsion of 1906 below Sukkur is the only one on the Indus of which I could ever obtain any record, either in the Punjab or in Sind. This is no doubt largely due to the extreme rarity of long, sharply curved cuts deep into the bank.

Assume for the moment that there is to be no heading up in floods. The river near the gorge runs from east to west. There will be an embankment running northwards from the gorge. It can easily be protected and maintained against breaches. The inhabitants of Sukkur would see to it, so would the engineers of the railway bridge. Part of the embankment would be on rock. The cutting in of the river could not occur there and is not likely to occur so as to destroy the rest of the embankment. At the very worst a stone guide-bank could be made in a suitable reach. This gives perfect control of a river, as everyone admits. The need for its construction is improbable. The project engineers and the present writer are obviously not the only persons who think as above. Many engineers suggest a barrage above the gorge (no heading up during high floods) and others with Indus experience advise the site below the gorge without a barrage. Obviously an avulsion would upset these schemes. The railway engineers were not afraid of the gorge site, for their bridge. The conclusion then is that in the absence of a barrage there is not much fear of an avulsion.

Now, let a barrage be made 3 miles below the gorge so as to head up the highest flood 1·34ft. The heading up above the gorge would be about ·75ft. The flood level can be watched, as in the case of a new embankment, and, if necessary, the embankments raised a foot. The cost will be a minor item.

What effect is this heading up of ·75ft.—or 1ft.—going to produce? There is nothing to show that it will have the slightest effect on any tendency of the river to cut in. All that must happen is that the embankment will have to be made so as to hold up the flood spill water a foot higher. This is all that is left of the spectre of avulsion. The spectre is the price paid for an incomparable site, one which needs no guide banks. At K, or other site, there might still be the spectre and certainly the guide banks.

Back-water.—When there is a heading up the raised surface, of course has a flattened slope, because Q is as before but A is increased, and converges steadily on the old surface. No matter how the depth or width of the sub-reaches may differ, each such sub-reach begins with the heading up with which the previous sub-reach ended and is governed by the same inexorable law. The rate of convergence may, of course, vary. Roughly, S varies as $\frac{1}{D^3}$ in each sub-reach. Mr. Woods' idea that the convergence need not be continuous shows ignorance of basic principles. Surgings, "boils," or "breathings"—where air has been imprisoned—occur in one sub-reach and make the observation of surface levels difficult, but at any point the surface, of course, has an average level.

In an irregular channel in actual flow one gets the surface longitudinal section by observation. We have it for a level of 201·74 at the gorge and an estimated, but quite consistent, section for a level of 205. Mr. Woods in his long descriptions of the irregularities implies that the flowing water has not taken them into account. He does not understand that it adjusts its level to the conditions and that all we have to do is to superpose on the actual longitudinal section the small changes due to the proposed heading up. These cannot, of course, appreciably affect the general conditions. In one short reach, where the section is rapidly increasing and the stream losing its tremendous momentum, the term $\frac{V_1^2 - V_2^2}{2g}$ cannot be neglected. A slight rise occurs. As before, there is a convergence on going upstream. Mr. Woods calls the rise "standing wave conditions." A standing wave—with its special formula—cannot occur unless $V > \sqrt{g\,d}$, and this is wholly impossible in the gorge. He thinks that the rise might be "damped out" by an "afflux of 3ft. or 4ft. at the barrage site." He does not understand that it could only be damped out if the rapid change in section became very much less marked. If it is damped out, he thinks that "the effect on afflux and velocity above the gorge might be very considerable." Someone else may like to try and interpret this. A statement thrown in about silt-laden water further obscures the matter. Silt has no known effect on velocity§, and if it has any it could have none on the adjustments which we are making to the surface curve.

Taking the heading up at the barrage site as 2ft., Mr. Woods actually gives a sketch showing it as increasing to 3ft. at the gorge 3 miles upstream. He thinks that the 3ft., though "somewhat conjectural," has been "rationally deduced." And he thinks that "common sense" comes in. A year or two ago it was 2·25ft. at the barrage, increasing to 3·5ft. at the gorge. In both cases—this time in italics—he speaks of the "narrow" or "narrowing" gorge. A light here breaks in. If the project engineers—say, by praying for rain—could cause a flood to rise, without any barrage, to 208 just above the gorge, they would get a steep slope down the gorge, somewhat as sketched by Mr. Woods. He confounds this curve, due to increase of Q and no barrage, with the one in which there is no increase of Q, but a small heading up which, of course, tapers off in going upstream. Even after a year he persists in the confusion. And he it is who accuses the engineers—on an average once in each column of print—of not knowing this or that, and tells them what they "ought to know."

E. S. Bellasis.

September 26th.

* A plan appeared in The Engineer of December 24th, 1926.

† *Indian Engineering*, April 2nd, 1927.

‡ "Hydraulics with Working Tables," by E. S. Bellasis, fourth edition, 1924, cap. IV., art. 15.

§ "River and Canal Engineering," by E. S. Bellasis, second edition, Cap. III., Art. 2.

RECENT BRITISH LOCOMOTIVES.

Sir,—If I may further encroach on your space I would like to enlarge on one or two points raised by correspondents in your issue of the 30th ult. Mr. Rickie advocates a system that is quite different from the normal continental compounds, and, in so doing, admits the seeming weakness of their design—low maximum tractive effort. This arrangement may be the solution to the problem, but it introduces another defect that will be very troublesome; that is, the excessive compression involved with a 20 to 25 per cent. cut-off and a back pressure of about 50 lb. or 60 lb. per square inch; the back pressure has to be kept very low in a simple engine if the above cut-offs are to be employed with profit, and the continental compounds of normal design find it necessary to employ a high-pressure cylinder clearance of 20 per cent. for cut-offs of the order of 50 per cent.

I would point out that the Midland compounds, although they have only one high-pressure cylinder, are essentially the same as the continental compounds. The arrangement advocated by Mr. Rickie entails as a basic principle a very low ratio between the high-pressure and low-pressure cylinder volumes. There seems to be a general misconception that a compound derives its improved efficiency from greater expansion of the steam than a simple, but a little consideration will show that this is not so; for normal high-speed work the ratio of expansion in both cases is probably the same, about four times; of course, in this comparison one must not take simple engines that are designed to utilise low-pressure with late cut-offs. The ratio of expansion of a simple can, of course, be varied greatly on either side of its normal working position, whereas with a compound the possible variation is very small; therein lies the weakness of the compound, and the strong point of the simple. The thermal advantage of a compound is due to some extent to the reduced temperature range in the cylinders, and also to the better shape of the diagrams, owing to the compression being taken in two stages instead of one. The advantage from this latter point is readily ascertainable theoretically, and is only about 12 per cent. under normal conditions; but in practice this is probably exceeded, as ideal conditions are more easily approached in the case of the compound engine.

All the above is very elementary, but it is worth setting out in view of the almost magical claims made in some quarters.

Mr. Rickie's report of the Baldwin 4–10–2 compound bears out what I have been able to find out about the continental machines, and that is that when it is working hard the high-pressure engines are little better than passengers. One hears a good deal about the high M.E.P. obtainable in a compound, but I have yet to see a convincing proof of this. In the correspondence columns of another journal last year, Mr. C. R. King published a pair of indicator cards presumably to prove this; but with a high pressure cut-off of 7 per cent., they only showed a M.E.P. referred to the high-pressure cylinder of 101 per cent. of the boiler pressure, and to obtain even this pressure the low-pressure was notched up to about 45 per cent. cut-off, with the result that the receiver drop was certainly eliminated; but the high-pressure engine was only responsible for about 30 per cent. of the power developed by the low-pressure engine alone. Now, Mr. King has asserted that a M.E.P. referred to the high-pressure of 143 per cent. of the boiler pressure is obtainable, and at the same time talks a lot about balanced piston loads. Can we not persuade this gentleman to publish a pair of cards that will illustrate the above claims? Of course, we can equalise the work between the high-pressure and low-pressure engines, but at the expense of receiver drop. Mr. Rickie's arrangement will equalise the work without receiver drop, but there will still be unequal initial loads on the pistons, and with the before mentioned trouble of high-pressure compression.

With all due respect to Mr. Ainsworth and his business friends, I must say that I am not at all surprised at the attitude of the G.W.R. They purchased at their own expense three French engines of a then star design, and surely they are entitled to their decision that the compound principle did not answer to their requirements as well as the simple engine, which they evolved from the French design, and nobody can deny that the G.W.R. locomotives perform their work in a brilliant manner. As regards the L.M.S., the matter is certainly a bit different, as they obviously deferred producing a six-coupled express locomotive as if they were not certain what type to adopt; but here again, as Mr. Rickie points out, they have 235 4–4–0 compounds now in service, and they have evidently decided that they lack something that is worth having.

Mr. Thompson points out that the Spanish 4–8–2 engines have to conform to a 16-ton axle weight. I am quite aware of this, and they also had to take into account low grade fuel, but I think there is not much doubt that a simple engine to do the work could be made smaller, lighter and cheaper, but it would burn more coal. I do not suggest it would be as suitable. It must not be forgotten that conditions as regards total weight, axle load, fuel and train service are quite different on the Continent of Europe to those obtaining in this country. The continental engineers most certainly know their job, but because our own locomotive engineers to a man arrive at a different and practically the same solution of their own problem, it does not follow that they are wrong. The total economy of a locomotive is not bound up in coal consumption, and it would seem that so far the design that gives the best overall efficiency in this country is the high-pressure simple of moderate total weight.

C. M. Keiller.

Cookham Dean, October 3rd.

Sir,—If the compound engines of the Great Western have not always proved themselves to be everything that has been claimed for them, it has mostly been due to the *personnel* of the engine staff. Great difficulty has been experienced by the company to get capable men to drive them. As is often the case, the best mechanical inventions do not always give satisfaction, from want of goodwill of those who work them, and I have continually seen this while being on the footplate. On the other hand, the "North Star" class have less working parts, and being 4–6–0 have more adhesion than the "Atlantic" compounds. My own experience of the de Glehn compound, both in this country and on the Northern Railway of France, is that in capable hands they are some of the most efficient locomotives that have ever been built, and the work they do between Boulogne and Paris on coal dust and a limited supply of "briquets" on a none too good road is marvellous.

It may be recalled that in 1911 the P.L.M. built two classes of "Pacific" engines for trial, a four-cylinder superheated simple type and a compound "Henri" type, and after immumerable trials the latter proved to be the most efficient.

October 3rd. B. W.

Sir,—I find I was in error when I stated in my letter which appears in your issue of September 30th, that a compound should be of the four-cylinder type. When writing I then had in view the use of the one high-pressure cylinder in the L.M. and S.R. engine.

The most powerful compound that can be designed is one that can be fitted with a L.P. cylinder or cylinders of the largest diameter; for instance, if a cylinder can be fitted in between the frames of a British locomotive the area of which will be greater than that of two 22½in. low-pressure cylinders, then a three-cylinder compound will obviously be the more powerful.

John Rickie.

Brockley, October 3rd.

MECHANICAL ENGINEERING IN THE ARMY.

Sir,—May I express my thorough agreement with the views expressed in your excellent article in the issue of the 23rd ult.?

To take away the control of the design of the motor vehicles they use from the R.A.S.C. appears on the face of it to be a very retrograde step. In the first place, those who have to use the vehicles seem the proper people to control the design. What would be thought of a railway company who gave the control of their locomotive designs to the permanent way staff and took it out of the hands of the locomotive superintendent? Further, at the present moment it seems that the R.A.S.C. has a *personnel* who know far more about the design of wheeled transport than any other department of the Army. We all know that at the beginning of the war mechanical transport had to be provided far in excess of the regular establishment at very short notice, and that this was done effectively. In all other of the larger branches of the Army, *e.g.*, artillery, cavalry, infantry, it was only the old regulars who went out first and all new levies were given a long course of training before going overseas. The R.A.S.C. could not do this, for transport was wanted at once. So vehicles were impressed, drivers enlisted and often sent overseas in a week or less. Yet the transport always did its work, and this fact shows the extreme efficiency of both the old regular staff of the R.A.S.C. and also of the temporary officers who joined it.

Now the R.A.S.C. has, of course, its old regular staff, and also some of the most able of the temporary officers who joined during the war, many of whom were very skilled motor engineers in private life.

Anyhow, during the early part of the war I think it is generally agreed that we always had enough transport, and that it did its work. Can it be said that we always had enough artillery and ammunition?

I have not been much in touch with the Army since the war, and it is, of course, possible that the Ordnance Department has acquired a staff of motor engineers capable of replacing those now in the R.A.S.C., but as one of the public who has to pay, I should like to be satisfied about this. The fact seems to be that the mechanisation of the Army will only be a success if it is done by really good mechanical engineers who thoroughly believe in it and have sympathy with it. It is, in fact, a matter of principle.

There are always two ways of doing any job. The one is to have large numbers of men, the other to have very efficient plant. You can, for instance, make a railway cutting in two ways—the first by having innumerable men with picks and shovels; the second, by having relatively few men with steam navvies, &c. The whole progress of the world consists of reducing the number of men actually used by increasing the efficiency of the plant. This is the instinct of all progressive engineers, whose one aim is to keep down the direct labour. It is also the feeling of the Navy, where the fighting power per man is enormous, owing to efficient mechanical handling of both the ship and the guns.

There is, however, I think, a very general feeling among civilians that the Army is not progressive in this way, and that its instinct is usually on the side of using a small amount of machinery and a very large number of men, and if this is the case the mechanisation can never be a real success. The one corps, however, which appears to be thoroughly progressive is the R.A.S.C., and therefore it seems a retrograde step to reduce its scope.

F. Strickland.

Bridlington, Yorkshire, October 1st.

THE FLETTNER RUDDER.

Sir,—With reference to your recent illustrated description of the Flettner rudders, as fitted to the t.s. ferry steamers Marlowe and Wallasey, I gather that the saving in coal is in some degree attributed to these rudders, which do not require a steam steering engine, as they are worked by the rush of water past the ship instead. I am inclined to think, however, that the Flettner fins which manœuvre the rudders are bound in so doing to cause extra resistance to the passage of the ship, and so compel the propelling engines to do the work, which in other vessels is done by the steam steering engine. Moreover, when the Flettner

rudders are being merely trailed, I expect their special form will cause some extra resistance.

As regards leaving the stage by immediately putting both propellers at the same speed ahead, I cannot see that the ship behaves any differently from what she would do if provided with a pair of ordinary plain spade rudders of the same size and shape, and in the same positions as the Flettner rudders, but operated by a steering engine which would set the rudders before the propellers began to revolve instead of after, as in the case of the Flettner rudders. In fact, I should expect that any slight advantage would be with the plain rudders.

To compare the evident handiness of the two new vessels with that of the others in the fleet seems unfair, as the latter have not got twin rudders—except the luggage boats—and even if they had, the comparison might be misleading if the forms of their hulls differed.

As to prime cost—that of the immersed portions of the new rudders must evidently be greater than if they were of the plain spade type. As for the remainder, there are two sets of control gears at the rudder heads, and there will doubtless be the item of patent royalties, but there is no steam steering engine. So on balance I doubt if there would be much either way.

It remains to be seen how the cost of maintenance of the new rudders works out over a period. It would appear that if any part of the submerged mechanism requires repair or adjustment, the ship will have to be docked to enable the affected parts to be got at.

V. J. MARTIN, Assoc. M. Inst. C.E.

West Kirby, Cheshire, October 4th.

THE PULVERISATION OF COAL.

SIR,—Your leader of September 30th bases an argument upon an estimate of 9·4 kWh per 1000 lb. of coal pulverised. This appears to us to be too high a figure to adopt as a basis for estimating the efficiency of a prospective new plant, as the art of pulverising has made great progress, even in the last few months.

In our practice as makers of pulverisers, we give a regular overall guarantee of 15 kWh per ton, and this covers our margin for contingencies due to moisture or to any unexpected special features of the particular coal being dealt with. In practice, with ordinary coal the figure is generally something under 12 kWh per ton, which gives a figure of about 5 kWh per 1000 lb. of coal dealt with. In the unit pulverisers to which this figure applies, the same power actually dries the coal and blows it into the furnace, so that from the total power consumed should be deducted the power required to operate the stokers dispensed with and part at least of the power required to operate the draught fans.

Taking all these matters into account, it would appear that the power required to pulverise the coal and to inject it into the furnace is little more than the power required to deal with the same variety of coal by means of a stoker.

ALFRED HERBERT, Ltd.,
P. V. VERNON, Director.

Coventry, October 4th.

THE WORK HARDENING OF STEEL BY ABRASION.

SIR,—I am indebted to you for pointing out in your leading article on "Hardness and Superhardness" that one of the conclusions drawn in my paper on the above subject was so stated as to be liable to mislead. You say: "Has the original hardness of a metal exposed to severe abrasion any effect on the resistance of the metal to wear?" "Mr. Herbert states definitely that it has not."

Now I might have been safe in concluding that since metal possessing original hardness does not exist in surfaces which have been subjected to severe abrasion, original hardness can have no direct influence on their resistance to wear, yet it is possible to suggest more than one way in which original hardness may be indirectly of great importance. One such way was suggested by your remark that "superhardening . . . cannot be an instantaneous process. . . . If it is soft to begin with, it may wear excessively before the superhardening effect has time to establish itself." I take leave to doubt whether this objection is valid.

I was recently attempting to cut a bar of soft manganese steel in a heavy bar lathe. The tool broke in two without removing a particle from the bar. There was no cutting, only abrasion, but the work hardening was instantaneous, and it sufficed completely to protect the steel from the effect of the very severe abrasion. Later, after the work-hardened surface had been ground away, a cut was actually started in a notch ground in the end of the bar. The hardness of the chip was found to be 682 Brinell. The hardness of the bar from which it was cut was 200 Brinell. In view of these results and others, I see no reason to doubt that in the case of a hard steel gear superhardening occurs, in its initial stage, instantaneously, on the first shock which causes plastic flow of the surface. The original hardness ceases to exist and therefore ceases to be a factor.

There is, however, another way in which original hardness is of great importance. It arises from the fact that the degree of superhardness which can be induced in any given steel is a function of its original hardness. It is not generally possible, by any process of cold work, to induce very high superhardness in a steel which was originally soft or only moderately hard. For example, a steel possessing the original hardness commonly found in gears—500 Brinell—can be superhardened by abrasion in service, by rolling with the pendulum, or by bombardment with steel balls in the new "Cloudburst" process, up to a maximum which may be 700 Brinell, but having attained this maximum its hardness will not be increased by any continuance of the cold working process, but will rather tend to decline. The same steel, if originally hardened up to 700 Brinell, could be superhardened up to, say, 1100 or 1200 Brinell, another definite maximum depending on the composition of the steel and on its original hardness, but incapable of being surpassed, unless by starting from a still higher original hardness.

This curious fact, established by innumerable experiments, may ultimately prove a useful clue to an understanding of the real nature of the work hardening and superhardening phenomena, but it unfortunately renders impracticable your suggestion that mechanical hardening may be used as a substitute for hardening by heat treatment. Any steel may be work-hardened up to the limit of its capacity, but it must be hardened before it can be superhardened.

It is true, as you point out, that one of the worn locomotive tires showed a surface hardness at one spot as high as 648 Brinell, but it is almost certain that this was not an effect of simple work hardening. The hard skin may have been produced by skidding on a sanded rail under conditions which caused the generation of a high temperature, but it would be entirely contrary to my experience that any soft steel should be capable of so high an induced hardness unless it contained a high percentage of some such element as manganese or chromium, which would impart to the steel a high work-hardening capacity. It may be a question worthy of study by railway engineers whether the work-hardening capacity of rail and tire steels cannot be increased by the use of some other and cheaper ingredient.

As to your question whether abrasion is a necessary antecedent to the production of superhardness, my investigations have led me to the definite conclusion that it is not. Superhardening occurs as a result of any cold-working process which causes plastic flow, whether the process be one of abrasion, cutting, rolling or bombardment.

EDWARD G. HERBERT.

Manchester, October 4th.

[In our leading article in last week's issue an unfortunate mistake resulted in the phrase "even if the word is used in some special sense" being inserted in a sentence to which it did not belong. The phrase was not intended to relate to the word "Cloudburst," but to the word "abrasion." The sentences should have read: "Is abrasion, even if the word is used in some special sense as Mr. Herbert seemed to admit in the discussion, a necessary antecedent to the production of hardness? . . . Mr. Herbert's "Cloudburst" process produces superhardness without, we suppose, causing abrasion."—ED. THE E.]

FIRST OR THIRD ANGLE PROJECTION.

SIR,—I have just read a copy of the B.E.S.A.'s British Standard Engineering Drawing-office Practice—No. 308, 1927—and am more or less surprised, but nevertheless pleased at the recommendation to use the First Angle Projection, and what is more, if any other method of projection, third angle or a combination of the two, is used a note should be added to the drawing to the effect.

The First Angle Projection is, as we all know, so to speak, the old English way of showing projection. The third angle projection has been imported from America, chiefly by American text-books, and is now the standard adopted by many large engineering firms. If these adopt the B.E.S.A. recommendations I beg to suggest that their workmen will, unless a copy of this report is shown them, be somewhat confused, since they are just beginning to get used to the third angle method.

I raise this point as it strikes me as such, otherwise I am, as one of the shopmen, pleased to see the publishing of the B.E.S.A.'s recommendations, as it will clear away many other minor differences, and if, may I again suggest, all engineering works adopt these recommendations and issue copies to their interested workmen, I am sure it will be appreciated.

J. WILSON.

Enfield Wash, October 3rd.

PASSENGER TANK ENGINES.

SIR,—When, fifteen years ago, I had occasion to discuss the employment of high-speed tank engines, I expressed the opinion that the safest and most reliable design of such engines would be one of the double-bogie type, with either four or six-coupled driving wheels. That view would appear to be correct, for, according to the tests, which Mr. C. A. Hunt mentions, carried out with different types of both tender and tank engines on the London, Brighton and South Coast Railway in 1922, the 4–6–4 tank engines of that line were found to be the steadiest of all.

The fact that the 4–6–4 came out better than the 4–4–0 tender type is interesting, but a good deal depends on the springing of the latter type, and on the manner in which the tender is coupled up to the engine. It will be remembered that in the case of some of the Prussian State Railways two-cylinder superheated engines, Dr. Garbe had the counterbalance weights for the reciprocating masses removed, and that in order to check the tendency to unsteadiness, a rigid coupling between engine and tender was adopted. The running was then said to be equal to that of multi-cylinder engines.

F. W. BREWER.

Stevenage, Herts., October 4th.

LOUGHBOROUGH COLLEGE.

SPEAKING on Presentation Day, last Saturday, at Loughborough College, Lord Riddell said that he considered that they were very bad advertisers in England, for if America owned Loughborough College the whole world would hear about it. Until he met Dr. Schofield, he had never heard of Loughborough, and there were many other people like himself at the present time. He had no conception of the magnificent plant owned by Loughborough College, no conception of its size and of the fundamental idea being carried out of teaching engineering as a human institution. Technical knowledge was essential for persons engaged in technical work. No one could hope to be a real success in engineering, unless they possessed certain other things. What were those other things? They were personality, the power of organisation, the power of managing men, tact and courage. In addition to those things, students of the College, notwithstanding their educational advantages, had to develop character. They did not live in the Samuel Smiles age, nowadays. They were all keen to get on in the world, and wanted to find the best way to do it. First of all, they must be technically instructed, and have technical details at their fingers' ends, but they must have character as well. In that respect he asked them to look into things for themselves. Because they were told a thing was right, it did not follow that it was right, and they should look into it. If they wanted to be successful in the management of working men, and working with trades unions, they must try to understand the point of view of the working man in the shop. He might be ignorant, and might not know what was good for him, and might not appreciate that they, in their little country, lived on their exports. They had only two natural commodities, coal and brains. He might not understand that they lived by the export of their brains, and so in dealing with him they must educate him by personal contact and geniality.

They all had their philosophies of life, and the philosophy of life of the English was geniality, of the Scotch efficiency, and of the Welsh sentimentality plus commercialism. A certain amount of adventure was also necessary in life, for life itself was an adventure. A man who always played for safety would not go very far. They could not have heroism without risk. They must take a certain amount of risk, and that was why their College was such a valuable educational asset to the country. Loughborough College comprised first-rate technical instruction, attention was paid to the development of character, and it had the qualities he had alluded to which were essential for success.

TEACHING EMPLOYEES THE THREE R's.*

INDUSTRIAL establishments which have undertaken programmes for the education of employees are finding that if their classes are to be broadly successful means must be provided to teach the three R's to a group of very considerable size. For the most part, let it be noted, this group is made up of young men who are native born and the product of American public schools.

To take a case in point, among the classes which have been conducted for some years by the Norton Company, Worcester, Mass., are those in commercial correspondence and applied mathematics. They have had a large measure of success, but too many instances have come to light where students were insufficiently grounded in the elements of grammar and arithmetic. The Norton Company uses the University Extension courses conducted by the State of Massachusetts. The educators who supervise this excellent system had already discovered this weakness and elemental courses had been provided. It was found that for the past two decades or longer grammar school courses have been so crowded with subjects that the pupils could not be given thorough training in grammar and arithmetic. Too much time would be required.

The result is that young people who must end their education at an early age lack the knowledge which pupils used to get in their grade school years. And now that the State has provided evening courses, not only persons who could not finish the grammar school course, but some who finished, but with indifferent results, may have a second chance. The new class in English at the Norton plant will start with thirty pupils. They will be taught grammar just as it is taught to twelve-year-old boys.

From the study of English by earnest men in evening classes the results have been highly beneficial, as many men now on their way up the industrial ladder can testify. To be able to express oneself clearly is an asset of no mean importance, and without correctness of diction clearness is often impossible. Straightforward, simple English—and such English is best of all, at any rate in business—may be mastered sufficiently well, provided one has the basic knowledge of the principles of grammar. Those who supervise the correspondence of business houses often deplore the handicap under which otherwise capable men labour because they are unable to express clearly in writing what is in their minds. The value of many men with well-recognised knowledge of a business is much impaired because they are unable to prepare adequate, easily digested reports of their investigations and accomplishments. To remedy such weakness is a highly commendable undertaking.

B.E.S.A. SPECIFICATIONS.

BALL BEARINGS AND PARALLEL-ROLLER BEARINGS.

A NEW specification recently issued by the British Engineering Standards Association covers the dimensions of ball bearings and parallel-roller bearings. Tables of dimensions are given for all the stock sizes of thirty-five types of journal and single and double-thrust bearings in general use, in both inch and metric sizes. Only the exterior dimensions of the bearings are prescribed; neither the internal dimensions and the design of the bearings, nor the materials entering into their composition are dealt with. The tolerances on the dimensions are specified, together with tables of permissible errors due to wobble and excentricity. Every bearing has been allotted a definite reference symbol, these symbols being compounded in such a manner as to make it possible to identify immediately both the particular type and size of a bearing without reference to an index. A standard nomenclature for the complete bearings and their component parts has been adopted.

It is intended to supplement this specification at a later date by the issue of further specifications for the dimensions of taper-roller bearings, and for such other types of ball and parallel-roller bearings as may be found desirable. Copies of the specification may be obtained from the B.E.S.A., Publications Department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

THE INSTITUTION OF CIVIL ENGINEERS. AWARDS.—The Council of the Institution of Civil Engineers has recently made the following awards:—The Howard Quinquennial Prize to Professor W. E. Dalby, F.R.S., M. Inst. C.E., in recognition of his researches on the strength and structure of iron and steel. The Indian Premium to Mr. A. W. Stonebridge, M. Inst. C.E.; for selected engineering papers published during session 1926-27:—A Telford Gold Medal to Sir E. Owen Williams, K.B.E., M. Inst. C.E. (London); Telford Premiums to Dr. E. H. Salmon, M. Inst. C.E. (London); to Mr. R. S. Cole, Assoc. M. Inst. C.E. (India); Dr. H. Mawson, Assoc. M. Inst. C.E. (Liverpool); and to Mr. A. H. Douglas, Assoc. M. Inst. C.E. (London); and a Crampton Prize to Mr. D. McLellan, M. Inst. C.E. (Glasgow); for papers read at students' meetings in London or by students before meetings of local Association during the same session—The James Forrest Medal, the James Prescott Joule Medal and a Miller Prize to Mr. R. F. Legget, Stud. Inst. C.E. (Liverpool); and Miller Prizes to Messrs. A. H. D. Markwick, Stud. Inst. C.E. (Ferrybridge); F. C. Jordan, Stud. Inst. C.E. (London); L. G. B. Rock, Stud. Inst. C.E. (London); C. J. Chaplin, Stud. Inst. C.E. (Wakefield); and F. V. Cornish, Stud. Inst. C.E. (Tankerton).

* From *Iron Age*, September 22nd, 1927.

The 24,000-Ton Motor Passenger Liner Saturnia.

The new 24,000-ton twin-screw passenger liner Saturnia, illustrated on page 398, has been built for the South American service of the "Cosulich" Line, Trieste. She was constructed at the Monfalcone Yard of the Cantiere Navale Triestino, and her engines were built by the Stabilimento Tecnico Triestino, of Trieste, under licence from Burmeister and Wain, Ltd. After undergoing successful trials the Saturnia has almost completed her maiden voyage to South America, and her addition to the Cosulich fleet marks a further step in the evolution of the large motor liner. The Saturnia is of interest to British engineers because, not only is she both larger and faster than the R.M.S.P. motor liners Asturias and Alcantara, but because her design, construction and machinery equipment have been superintended in all stages by Mr. James M. Dowar and Mr. A. T. Wall, who in 1924 were appointed by the "Cosulich" Line as the consulting naval architects and marine engineers for the Saturnia and her sister ship the Vulcania. Again, some of the auxiliary machinery and navigational equipment have been supplied by British firms, a fact which lends additional interest to the ship, which for the time being ranks as the largest and fastest motor liner afloat.

Hull Design and Passenger Accommodation.—The Saturnia was completed towards the middle of September, and after undergoing her official trials in the Adriatic she left Trieste on Wednesday, September 21st, and arrived at Marseilles shortly before midnight the following Sunday evening. At midday on Monday, September 26th, the vessel left Marseilles for Las Palmas and Rio de Janeiro. She was scheduled to reach Rio de Janeiro on October 5th, and Buenos Aires on October 8th. The excellent trial performance of the ship was repeated during the first part of her trip, for she completed a run of nearly 100 miles from Trieste to the island of Lussin-Piccolo, off Istria, at a speed of 20 to 21 knots, while the remaining part of the voyage to Marseilles and Las Palmas was accomplished at speeds well over her designed service speed of 19 to 19·25 knots. This increase in speed of over 3 knots as compared with R.M.S.P. liners, already referred to, has been obtained with practically similar propelling machinery in a ship of but slightly larger dimensions, by the adoption of higher engine revolutions, the installation of separate air compressors, the use of supercharging, and the fitting of Contra-propeller blades on the hull. In the table which follows we give the principal dimensions and particulars of the vessel.

Hull Particulars.

Length overall	192·45 m. (631ft. 5in.)
Length between perpendiculars	182·575 m. (599ft.)
Breadth moulded, maximum	24·23 m. (79ft. 6in.)
Depth moulded to main deck	13·17 m. (46ft. 3in.)
Normal machinery output	18,000 S.H.P.
Maximum output supercharged	20,000 S.H.P.
Designed service speed	19–19·25 knots
Gross tonnage	23,900 tons.

Passenger Accommodation.

First class	279
Second class	257
Second class economic	309
Third class	1352
Officers and crew	441
Total ship's complement	2638 persons

Cargo Carrying Capacity.

Total cargo carried	4600 tons
Refrigerated space	72,300 cubic feet
Chilled space	52,600 cubic feet
Fresh water	2500 tons
Fuel oil	2300 tons

Our illustration of the Saturnia on page 398 is a view of the ship taken on her trial run, which shows clearly her individual character. Much of the pleasing quality of her appearance is lent by the large single elliptical funnel, which, with the two masts and well-raised superstructure, gives the vessel a handsome appearance.

The Saturnia was designed and built to the highest requirements of Lloyd's Register and the Registro Italiana, and the consulting naval architects and marine engineers, Messrs. Dowar and Wall, were represented on site by their resident inspector, Mr. William Donald. Before the keel was laid careful experiments were carried out by Dr. Gebers at the Vienna Tank, and it is satisfactory to learn that the horse-power obtained during the trial runs corresponded very closely with that predicted by the tank tests. Interesting features of the hull construction are the use of steel of high elastic limit for the superstructure erections, and the special care which was taken in the building up of the engine seats for both main propelling engines and auxiliary machinery, which were both riveted and welded. A duct-keel runs about two-thirds the length of the ship and greatly facilitates the grouping of piping and the pumping arrangements. The double bottom is carried fore and aft and is divided into eleven water-tight compartments by ten bulkheads fitted with water-tight doors on the Stone principle. There are six cargo holds, three forward and three aft of the machinery space. The passenger accommodation is arranged on eight decks "A" to "H." On the starboard side of "A" deck are first-class single-berth cabins, while on the port side are the quarters for the engineers and deck officers. Deck "B" is occupied by the principal first-class public rooms, which include a lounge, social hall and ball room, a grill room and writing room, a library, tea room, and smoking room. The lounge is formed with a verandah on three sides, which is enclosed by sliding windows, and in it is a staircase giving access to all decks. The social hall has a length of 62ft., with a breadth of 49ft. The grill room is a further innovation, which, together with the quick lunch counter in the main dining room, should be popular with South American passengers. The social hall and grill room were decorated by the firm of Coppedè, of Florence, and the writing and reading rooms were completed to the designs of Marsh, Jones and Cribb, of Leeds, in conjunction with the Bath Cabinet Makers Company, Ltd. The latter two firms also decorated and furnished the main dining room on "F" deck, which has accommodation for about 270 persons at small tables. The main part of "C" deck is given over to first-class cabins, and a new feature is the provision of thirty-eight suites de luxe and two suites imperial, which have, in addition to a state room with two beds and a bathroom, a private verandah with a length of 8ft. and width of 5ft. facing on the sea. All rooms on this deck are specially insulated with cork to eliminate any noise. In all the first-class cabins telephones have been arranged, while both hot and cold water are laid on to the cabins of all classes. On "D" deck there is further second-class cabin accommodation and some public rooms, while on "E" deck there is a third-class dining room and other rooms forward, with the economic second-class dining room and public rooms aft. The kitchen galleys for both these dining rooms and that of the crew are also arranged amidships on this deck, along with a well-equipped infirmary. On "F" deck are to be found the first and second-class dining rooms, with the galleys and store rooms arranged between them. The latest type of baking and cooking ranges are fitted, which have largely been supplied by British makers. There is additional cabin space on "G" and "H" decks for second and third-class passengers and emigrants. Immediately forward of the auxiliary engine-room casing on "H" deck is a first-class gymnasium, together with the swimming pool and Turkish bath. The swimming pool is probably the finest of its type yet constructed. It has a length of 42ft. and a width of 10ft. and is built in Italian marble. The roof is studded with a series of blended lights which give a daylight effect. This part of the ship is placed in easy communication with the first-class decks by means of a staircase and also lifts. Ample promenade deck space is arranged for all classes of passengers, and first-class passengers are provided with a good sports deck at flying bridge level. A new feature is the provision of a barber's shop for each passenger class. A certain part of the hold is specially set apart for the storage and carrying of motor cars.

Deck Auxiliaries and Navigational Equipment.—Practically the whole of the auxiliary machinery in the ship is electrically operated. The deck auxiliaries comprise eight Laurence-Scott worm-geared 3-ton winches and two 5-ton Italian winches for the rapid handling of cargo. The anchor windlass was supplied by Clark, Chapman and Co., Ltd., while the capstans are of the Thrige type. Brown Bros., of Edinburgh, made the steering gear, which is installed in a spacious compartment. The ship is capable of turning in about twice her own length. Refrigerating plant has been provided both for the cargo holds and the provision room and pantry requirements. It is of the Haslam CO_2 type and is electrically driven. There are thirty-two lifeboats with Columbus davits and Atlas boat lowering gear. Two of these are motor lifeboats and carry a wireless installation. The emergency generator set, which is carried on "B" deck well above the water line, is designed to supply ample current for lighting and also manipulating the boat winches, life-saving appliances and wireless installation. The main wireless equipment comprises a 3-kW set and a 1½-kW set.

Instruments for the navigation of the ship include a Sperry gyro compass and gyro pilot, a Hughes echo-sounding gear and an O'Neil helm indicator. As before mentioned, water-tight doors of the Stone type, which can be operated from the bridge, are fitted between the engine-rooms and tunnels. The fire-extinguishing installation is of the Rich type, with a combined detector cabinet and CO_2 gas distribution network. The heating of the ship is mainly steam and the ventilation is an elaborate and highly efficient system of the Thermo Tank Company's punkah-louvre type. In the public rooms the ventilating louvres are fitted with impeller blades which deflect and distribute the supply of air. The Thermotank equipment is arranged aft of the funnel on the top deck, and in winter the heat of the exhaust gases can be utilised for warming the air delivered to the ship if so desired.

Main Propelling Engines and Auxiliaries.—The main engines are similar in type and cylinder dimensions to those installed in the liners Asturias and Alcantara, which have already been described in The Engineer. The interest in the present installation is mainly that supercharging blowers have been added which raise the output of each of the two main engines from 9000 to 10,000 S.H.P., and separate injection air compressors have been provided. The whole of the machinery is arranged in two engine-rooms. The main engine-room is slightly aft of 'midships and has a length of 72ft., while immediately forward of it is the auxiliary engine-room, which is about 48ft. in length. Although separate injection air compressors for the main engines, together with the generator sets, are placed in the auxiliary engine-room, a small air compressor unit and a generator unit are installed, one on each side of the main engine-room, so that in the remote event of the auxiliary room being flooded the main engines could still be operated at a reduced output.

In the following table we give the principal particulars of the machinery installation :—

Main and Auxiliary Engines.

Main Propelling Engines—

Type : Twin-screw, B. and W., four-stroke, double-acting	
Number of cylinders	8 each engine
Bore	840 mm.
Stroke	1500 mm.
Maximum speed	125 r.p.m.
Normal output each engine	9000 S.H.P.
Maximum output each engine supercharged	10,000 S.H.P.

Auxiliary Engines in Main Engine-room—

One four-cylinder, 900 B.H.P. air compressor set. Designed output 3800 cubic metres per hour.
One three-cylinder, 675 B.H.P., 450-kW generator set.

Supercharging Blowers in Main Engine-room—

Two 150 B.H.P., 1500 r.p.m., electrically driven turbo-blowers. Air pressures 470 to 500 mm. (about 2 lb. gauge).

Heating Boilers in Main Engine-room—

Two Cochran type boilers, oil fired, each 19ft. 3in. high and 8ft. 6in. diameter. Duty, 7000 lb. per hour at 100 lb. pressure ; heating surface, 1000 square feet.

Engines in Auxiliary Engine-room—

Two six-cylinder, 1350 B.H.P. air compressor sets, 80 to 180 r.p.m. Maximum output 5800 cubic metres per hour.
Two six-cylinder, 1350 B.H.P., 900-kW generator sets.

The main engines were built by the Stabilimento Tecnico Triestino at Trieste, to the design of Burmeister and Wain, Ltd., and are the first large engines of the type which have been constructed by the firm. The auxiliary engines are all of the standard B. and W. trunk piston type with a bore of 500 mm. and a stroke of 1000 mm., which enables a considerable reduction to be made in the number of spare parts carried. They were constructed by the A.E.G. Company, of Berlin, which firm also built the direct-coupled three-cylinder three-stage air compressors, and the electrically driven turbo-blowers. The turbo-blowers are placed high up in the main engine-room and are provided with convenient controls which can be worked in a simple manner from the main starting platform. The two oil-fired heating boilers are placed near the after bulkhead and the uptakes are carried up the main funnel casing, entering it at an oblique angle, which is indicated by the rear slope of the funnel at its base. Silencers for the main and auxiliary engines are also accommodated in the funnel casing. Most of the pumps in the engine-room are of the electrically driven centrifugal type, although some vertical plunger pumps are fitted for bilge and general duties. There are twelve sea-water circulating pumps for the main and auxiliary engines and four fresh-water pumps, while further pumping units include those for the lubricating oil and piston cooling services and for bilge, general purpose, fire and sanitary uses. Most of the pumps were supplied by the Italian firm of Cerpelli. Provision has been made for a control station for pumping services, and the duct keel already mentioned has greatly simplified the pipe arrangements. In the auxiliary engine-room there is a common raised platform for the four air compressor and generator sets, and the main switchboard runs the full breadth of the engine-room at platform level. A feature of the electrical installation is the provision of sub-stations for the distribution mains at various parts of the ship. There are about 250 electric motors, and these, together with the generators and 220 110-volt motor generators for lighting service, were all built by the Cantiere Navale Triestino.

The illustration on page 398 shows the port engine on its test bed at the builders' works. After the machinery had been installed in the ship preliminary trials were run under full-power conditions, which gave the ship a speed of about 20½ knots over a period of three hours. At a somewhat late stage in the design of the ship it was decided to fit Contra-propeller vanes on the hull of the vessel, in order to deflect the water on to the two propellers, and trials were carried out at the Hamburg Tank before the Contra-propellers were fitted. During the extended trials at sea it was shown that the Contra-propeller blades had a decided effect on the engine revolutions. Under maximum power conditions on the test bed the engines gave a total indicated horse-power of 24,000 when running at a maximum speed of 125 revolutions. At sea, however, when the machinery was run under the combined conditions of most suitable fuel supply, injection air pressure, and supercharging pressure, an engine speed of 120 r.p.m. was the maximum that could be obtained. At these revolutions, however, the power of the engines was about 22,000 I.H.P. and the speed of the ship 20·6 knots, the vessel being loaded corresponding to a displacement of about 23,000 metric tons.

A feature of the trials was, we understand, the total absence of vibration in the ship at her designed speed, which no doubt is largely due to the care expended in the design and construction of the engine seatings and to the lightening and balancing of the reciprocating parts of the auxiliary machinery. It was shown that the ship possesses ample reserve of power, and it is probable that she will be able to make eight or nine round trips between Italy and South America in a year. As yet the exact consumption of fuel for all purposes cannot be accurately stated, but it is expected not to exceed about 90 tons per day of twenty-four hours, which is, we understand, a most liberal estimate. The second "Cosulich" liner, the Vulcania, is now well advanced, and is expected to make her first trip early in February next ; after visiting New York, she will in all probability make the return voyage to an English port.

EDUCATIONAL INTELLIGENCE.

UNIVERSITY OF LONDON.

A course of four lectures on "Heat Transfer in Reciprocating Engines, including Internal Combustion Engines," will be given at the Institution of Civil Engineers, Great George-street, Westminster, S.W. 1, by Professor Dr. Adolf Nägel, of the Technische Hochschule, Dresden, at 5.30 p.m., on Thuesdays and Fridays, October 11th, 14th, 18th and 21st, 1927.

Syllabus.

Lecture I.: October 11th.—Chairman, Sir Henry Fowler, K.B.E., LL.D. The importance of the transfer of heat between the working substance and the cylinder walls in connection with the development of the piston engine. Earlier calculations and experiments on the steam engine : The calculations of Grashof, 1884 ; Kirsch, 1886 ; Fliegner, 1897 ; Nadal, 1897–8 ; the experiments of Donkin, 1895 ; of Callendar and Nicholson, 1897.

Lecture II.: October 14th.—Chairman, Dr. W. B. Worthington, D.Sc., M. Inst. C.E., M.I. Mech. E. Later calculations and experimental determinations of the transfer of heat in steam and in internal combustion engines : (*a*) Steam engines—Experiments of Duchesne, 1906 ; Heinrich, 1912 ; calculations of Nusselt, 1916. (*b*) Internal combustion engines—Calculations and experiments of Witz, 1878 and 1883 ; Meyer, Wach, Dugald Clerk, 1906 ; Junkers, 1912 ; David, 1913 ; Nusselt, 1914 and 1923 ; Neumann, 1921 ; Eichelberg, 1923 ; Herzfeld, 1924.

Lecture III.: October 18th.—Chairman, Sir Dugald Clerk, K.B.E., J.P., F.R.S. Arrangement of experiments to indicate the temperature on the inner walls of a uniflow steam engine cylinder in the heat engines laboratory, the Technische Hochschule, Dresden, 1911 to 1922. Application of this method of testing to the working cylinder of a large two-stroke Diesel engine at the works of Gebrüder Sulzer, Winterthur, Switzerland.

Lecture IV.: October 21st.—Chairman, Sir Archibald Ross, K.B.E., M. Inst. C.E., M.I. Mech. E. Discussion of the best results obtained by means of the temperature-indicating apparatus (*a*) on the uniflow steam engine at the Technische Hochschule, Dresden ; (*b*) on the large Diesel engine belonging to Gebrüder Sulzer, Winterthur.

The lectures, which will be delivered in English and illustrated by lantern slides, are addressed to students of the University and to others interested in the subject. Admission free, without ticket.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Situation.

Hopes of an autumn revival in trade are fairly general amongst industrialists in the Midlands and Staffordshire, and as a result, the tone of the iron and steel market is brighter. The slight improvement noted last week is maintained, though it cannot safely be said that it has been added to. Next week's quarterly meeting of the Midland iron trade in Birmingham is expected to throw some light on the prospects for what remains of the year 1927. Some fairly substantial business is anticipated from constructional engineers, and it is thought that consumers of iron will also take the opportunity of replenishing their now depleted—if not exhausted—stocks. Enquiries have been circulating freely this week, and on 'Change to-day the firm attitude taken up by producers with regard to prices was remarked upon. Market stability is necessary to any real progress in buying, and is one of the main things now desired.

Raw Iron.

Headway continues to be made in the raw iron market, though there is nothing of a spectacular character. Merchants report that they are receiving more inquiries, and blast-furnacemen speak of improved sales though these transactions continue to lack bulk. Some buyers, however, have placed orders for January and February delivery, and it is thought that others may follow their example. Output, although restricted, is sufficient to meet demand. For the time being the putting out of furnaces has ceased, and it is believed that more plant will be required shortly. Stocks in users' hands are very small, and in many cases are approaching exhaustion. Last week's attempt on the part of some blast-furnacemen to increase prices was countered this week by a resumption on the part of consumers of the pressure for lower values. Sellers showed no sign of yielding, and many buyers have now come to the conclusion that prices in this department have reached bottom. In a few special cases, it was stated on 'Change to-day, prices rather better than £3 5s. have been paid for Derbyshire No. 3 foundry. The figure named is the accepted basis, however, and there is no difficulty in getting pig iron at that rate. Northamptonshire houses quote £3 0s. 6d. to £3 1s. Business in forge material is negligible. Last week's improved inquiries have not been maintained. Values are difficult to determine.

Steel.

Business in steel continues to progress unostentatiously. The rolling lists issued by the mills indicate that they are producing a wide variety of products. One advantage of the present position is that delivery of nearly any class of material can be given at a few hours' notice. Orders continue for small tonnages, but next week's quarterly meeting in Birmingham is expected to bring out some really good lines. Constructional engineers are known to have need of fairly large tonnages of material, and some forward contracting next week would not come as a surprise to local steelmasters. They know that customers' stocks are practically exhausted, and now that some semblance of price stability has been achieved in the structional steel department, there should be sufficient confidence, they think, in the future to warrant the renewing of stocks. Steelmasters here now consider that buyers are taking more kindly to the rebate scheme, and many are convinced that increased business will result therefrom. Quotations alike of finished steel and semis are unchanged, and in no department of the steel trade is price shading in evidence. Angles and joists are quoted at £7 12s. 6d., tees £8 12s. 6d.; ship, bridge and tank plates, £8 7s. 6d.; boiler plates, £11 to £11 10s.; small steel bars, £7 15s.; and mild steel billets, £6 10s. Staffordshire hoops are maintained at £10 10s. at works. There does not appear to be any great magnitude of business going to foreign competitors for local consumption, but Birmingham merchants are buying fair quantities for export.

Finished Iron.

The Staffordshire finished iron trade shows no sign of improvement. Business is of small amount and irregular. Marked bars are unchanged at the basis of £13 10s. The mills are, speaking generally, none too well employed, but this department is less depressed than that dealing with lower grade bars. There is considerable disparity in the quotations of Crown bars. Staffordshire iron of this quality is offered at from £10 to £10 10s., but supplies are obtainable on the Birmingham market at £9 10s. Endeavours are being made to regularise quotations, but so far nothing definite has resulted. Associated makers in Staffordshire state that the low prices at which bars are being offered by mills outside do not represent the district position. A figure as high as £10 15s. is even mentioned. Trade in common bars is negligible. Reports from Darlaston indicate that the nut and bolt trade is extremely quiet. British-made iron suitable for that industry is quoted at £9 upwards. This figure is substantially in advance of imported iron, and the bulk of the orders are going to the Continent.

Galvanised Sheets.

The galvanised sheet trade is experiencing a rather dull time, very few orders coming in, and there are hardly any inquiries. The nominal quotation of £14 is maintained, but business is done at £13 17s. 6d., and many mills, it is stated, would be willing to take £13 15s. for a good order.

The Crushing Burden of Taxation.

Manufacturers and industrialists in the Midlands are generally agreed that Mr. Gilbert C. Vyle, of Birmingham, President of the Association of British Chambers of Commerce, hit the nail squarely on the head when he attributed, at the meeting at Liverpool of that body, to the crushing burdens of taxation on industry, a great proportion of the difficulties which prevent British trade expanding as rapidly as it should. The burdens which industry had to bear, he said, were destroying initiative and retarding the development and progress of our industries. He declared that the promise of the year had not been fulfilled, and he indicated that economy in national and local expenditure was necessary to a trade revival. Industrialists in this area, realising that taxation is over four times what it was in 1914, and that the expenditure of local authorities, out of funds raised locally, had doubled, consider, with Mr. Vyle, that the time has come to call a halt. A definite reduction in rates is needed, they urge, and the least the Government can do is to set its face sternly against any legislation that is calculated to increase the demands upon the taxpayer.

Cannock Chase Wages and Losses.

Cannock Chase and Pelsall miners' wages for October, which are based on the results of the local coal industry during June, July and August, will be the same as for the past four months, viz., 42 per cent. on the 1911 wage basis, which will give stallman a minimum wage of 9s. 4d. per day. It is pointed out by the owners, however, that the industry is really not able to pay more than 12·07 per cent. on basis rates, and that the loss per ton of coal during August was 10½d. The terms of the agreement, however, provide for the payment of the minimum of 42 per cent. already mentioned. There is now a total deficiency of £398,000, compared with £248,000 a month ago, to be carried forward, which amount will have to be met out of the proceeds of the coming winter months, when, it is hoped, the wages ascertainments will be on the up grade. The reported action of various miners' organisations to attempt to secure a simultaneous termination of wages agreements does not find much support on Cannock Chase, for the men think that under any new national agreement their present minimum, which is higher than in most parts of the country, and is safe for more than a further two years, might be reduced.

Warwickshire Miners' Wages.

The percentage on basis wages in the Warwickshire coalfield, which for September was 51 per cent., falls for October to 47 per cent. This reduction, however, does not affect all workers in the coalfields, as surfacemen will, under the agreement as to subsistence wage, only suffer a drop of a penny per shift—from 7s. 3d. to 7s. 2d.—whilst underground workers do not fall below the subsistence minimum of 8s. 3d. per shift as in September.

Steel Better than Timber.

That steel girders are preferable to timber supports in mines is emphasised by Mr. H. A. Abbott in his annual report as inspector of the Midland and Southern area, just published by the Department of Mines. Mr. Abbott states that 1926 was adversely affected by the prolonged coal stoppage. Fortunately, the safety men remained at work, and thereby the mines were largely preserved in a condition ready to absorb large numbers of miners on the termination of the dispute. In this respect, where steel arches for the support of roadways were used, they amply proved their superiority over timber supports. Although the first cost is two or three times that of timber, they are more economical in the long run, provide a greater degree of safety, and by eliminating to a large extent heavy falls of ground on the roadways, they prevent the resultant disorganisation of parts, and sometimes whole districts of the mine. Considerable local interest attaches to that portion of the inspector's report which states that the number of mines worked in the division, which includes Cannock Chase, South Staffordshire, and Salop, is 445. The total number of persons employed during last year in all capacities at the mines in the area was 110,387, including 31,495 in Cannock Chase and 3787 in Salop. In an appendix giving particulars of mines abandoned during the past year are mentioned 9 seams in Salop and 17 in South Staffordshire, none of the latter, however, being in the Cannock Chase district.

Canal Bridges.

The question of restricted loads over canal bridges, of which I have written from time to time, being of such vital importance to Midland industrialists, is being kept well to the fore, and a meeting recently of the Midland Association of Local Authorities considered proposals which have been formulated for the taking over of canal bridges by the highway authorities, or for alterations and extensions to the structures. Information of an engineering nature, collated from the various districts concerned, was placed before the meeting, and it is anticipated that a comprehensive scheme will be submitted to the next meeting of the Association. The Ministry of Transport has been asked to receive a deputation.

Midland Ironworkers' Wages.

The wages of ironworkers in the Midlands, which are regulated by a sliding scale under the Midland Iron and Steel Wages Board, have, consequent upon the usual bi-monthly ascertainment, been reduced a further 2½ per cent. as from Monday last. This award, which prevails until December 3rd, is the fourth reduction this year. The July ascertainment resulted in a reduction of 5 per cent., the May in one of 2½ per cent., and the March in one of 6 per cent., a total fall of 15 per cent. since the year opened.

Unemployment.

We in the Midlands are congratulating ourselves on the progress which is being made regarding the absorption of labour into local industries. For some time now the returns have been steadily declining, though, of course, unemployment is still much worse than before the upheaval seventeen months ago. The position has, however, been materially bettered since the beginning of the present year. At that time there were nearly 38,000 unemployed in Birmingham alone, and about 192,000 in the Midlands generally. To-day the Birmingham figure stands at 26,049, and for the area as a whole at 128,962. Following a decrease of 7058 a week ago is one this week of 3217. In the latest total are included 46,591 persons who are known to be working short time or who are unemployed temporarily. Unfortunately, it is impossible to record that the basic industries of the area have contributed much to the amended position.

LANCASHIRE.

(From our own Correspondents.)

Manchester.

The Engineering Outlook.

A summing up of the position in the engineering industries in this district appears in the current issue of the Manchester Chamber of Commerce monthly bulletin in the following terms: The engineering trade has naturally been interested in the concessions made recently by the Cleveland pig iron makers and in the steel makers' rebate scheme for those who use only British steel. The immediate effects do not appear to have been large in either case, but that could hardly have been expected in view of the contracts running for foreign supplies, and other difficulties in the way of giving home steel makers a monopoly. Heavy electrical engineering, cable making, constructional engineering, and motor car manufacture are still busy sections, but locomotive builders are not generally fully employed, and machine tool makers' trade continues dull. Textile machinists are still hoping to get new orders from Russia, and it is believed that good business with China will be possible when that country settles down. Makers of artificial silk machinery are generally well engaged, chiefly for the home market.

Industry and Rates.

Manchester trade and industry during the past year or two have, through the Chamber of Commerce, endeavoured to lessen the damaging effect of the weight of local taxation, and it is not very long since an official deputation from the Chamber waited upon the city authorities and presented ample evidence of the heavily increased overhead charges which industry had to bear because of the rates burden. Several instances of engineering works were given as concrete examples. The matter was further dealt with by Mr. Thomas Keens in his presidential address at the autumnal meeting of the Society of Incorporated Accountants and Auditors just held here. In Mr. Keens' view there can be no question as to the serious effect of rates, particularly in regard to "small business" as opposed to "big business." The average rate throughout the country has increased from 6s. 8½d. in 1913–14 to 12s. 1½d. in 1924, and the total amount of rates paid from £71,276,000 to £143,275,000. The influence of this rating upon the cost of manufacture is enormous, and, according to Mr. Keens, cases are known in which the charges for rates and special insurance in producing a ton of steel from coal and ore had risen from 3s. 3d. in 1913 to 10s. 3d. in 1923, or an increase of 215 per cent. "The tragedy is," he said, "that while the rates have increased enormously output has been reduced, and the weight of the burden on a unit of production is increased both ways. Rates become higher, output smaller, costs are increased, and the power to compete is lost. This is particularly manifested in shipbuilding. In one case the cost of rates in 1913 represented 8½d. per ton deadweight and in 1926 7s. 5d."

The Cost of Electricity Supply.

Several interesting points were made by Alderman William Walker, deputy-chairman of the Manchester Electricity Committee and a member of the Central Electricity Board, in a speech in connection with the opening this week of the Manchester district "Electricity in the Home" campaign, organised by the British Electrical Development Association. The Government, he thought, could give the electrical industry valuable assistance on the distribution side by facilitating wayleaves and by reducing so-called safeguards which so largely increased the cost of low-tension distribution. Low-tension systems on the Continent were put down at a cost of from £100 to £150 a mile, whilst the cost in this country varied between £400 and £600 a mile. Mr. Walker dealt also with a common public belief that in the immediate future there was going to be an ample supply of electricity for everyone at a cost of a halfpenny or a farthing a unit. Whatever might be accomplished some day that, he said, was obviously an impossibility in the near future. Progress in this matter could only be gradual, though every effort was being made to secure a more nearly universal supply of current at a lower and still lower cost.

Meeting the Demand for Bigger Locomotives.

Works extensions to meet modern needs are referred to in the report of the directors of the Vulcan Foundry Company, Ltd., Newton-le-Willows, for the year ending June 30th. Chiefly in consequence of the increased size and weight of main line locomotives certain extensions of the company's works are in progress with a view to providing improved facilities for dealing with these modern developments. The report points out that considering the serious difficulties that arose during and after the coal stoppage the result of the year's business is better than could reasonably have been expected. It is considered that there are now good prospects of continuous service throughout the current year if industrial peace prevails. The profit on the ordinary shares is maintained at 10 per cent., and a final dividend of 2½ per cent on the preference shares, making 5 per cent. for the year, is recommended.

Non-ferrous Metals.

Although tin values have recovered to the extent of about £3 a ton compared with the price for cash metal quoted in this column a week ago, it seems to be merely

a partial return swing of the pendulum which was to be expected after the serious fall of the previous week. The fact remains, notwithstanding that the market during the early days of the present week was steadier than at the close last Friday, that there is little general confidence in an early appreciable recovery, partially because of the belief that "bearish" influences that have recently been active have not yet tired, but partly also because of the indisputable fact that the demand in this country, as well as in the United States, is far from sufficient to afford adequate support to a market that is the sport of outside influences. In the case of copper, also, although cable-makers have been in the market for certain quantities, buyers have been less in evidence than sellers, and the tendency of industrial users generally is to restrict their purchases as far as possible. On balance, however, values have not receded any further; if anything, both cash and forward metal are fractionally dearer than they were a week ago. A meagre demand in both cases, coupled with plentiful supplies, has had a distinctly weakening influence on lead and spelter. Current values of the former represent a further loss of 10s. a ton, whilst spelter, which had been fairly steady for some weeks, has experienced a serious fall.

Iron.

A not unexpected development on the pig iron market in this area during the week has been the attempt on the part of certain makers of Derbyshire common iron to secure a more economic price for their product than has been ruling for some time now. So far, however, the attempt has been confined to those producers who are in a stronger statistical position. One or two of the biggest makers have booked orders for fairly substantial quantities during the past month, and, incidentally, have succeeded in making an almost complete clearance of stocks which previously had been showing unmistakable signs of growing. It is these sellers who have taken the initial step. Thus far, few have followed their lead, but it is fully expected that they will do so before very long. At the increased price of 74s. per ton, delivered Manchester or equal, there has not been the same demand as before, although fair sales have been effected. For the time being, Staffordshire No. 3 remains at 73s. 9d., delivered here, with Middlesbrough at 80s. 8d., Scottish at 90s. to 91s., and hematite at 87s. 6d. Bar iron makers continue to complain of the poorness of the demand for their products, but values are unchanged at £10 for Lancashire Crown quality and £9 10s. for seconds.

Steel.

British steel makers on this market report orders for a moderate tonnage of tank plates and sections, some of it against unexpired contracts, and the remainder new business for early delivery, fresh contract commitments still being almost unheard of. The demand for steel bars and for boiler-plates, however, has been slow, and there is relatively little inquiry in the market. The latter range from £10 15s. to £11 per ton; with bars at £7 15s. to £8 10s.; and tank plates and sections at £8 7s. 6d. and £7 12s. 6d. per ton. Up to now the expressed intention of foreign steel makers to secure improved prices has come to nought, largely because they are being effectively undersold from several directions. In any event, so far as this area is concerned, there has been little buying recently on an important scale. For delivery to Lancashire buyers' works for net cash against shipping documents, continental billets are being offered at £4 18s. 6d.; sheet bars at £5 to £5 2s.; joists and sections at £5 13s. to £5 15s.; Siemens plates at £7 10s.; Thomas plates at £7 2s. 6d.; wire rods at £6 7s. 6d.; steel bars at about £5 13s.; and Belgian bar iron at £5 14s. per ton.

BARROW-IN-FURNESS.

Hematite.

The condition of the hematite pig iron market, as far as the North-West district is concerned, is not good at present. There is a slight falling off in orders as far as tonnage is concerned, and customers are reducing their requirements to the lowest, despite the recent reduction in price. The result of this thinning of orders is that in some places stocks are beginning to accumulate, and that cannot go on indefinitely for obvious reasons. Stocks are rising most in works which are not allied to steel production, and if there is no improvement soon there will have to be a restriction of output. Works, such as those at Barrow and Workington, where the steel departments are taking a considerable amount are keeping stocks down, but even with them there is a tendency for output to leave a margin. Trade may take a better turn, but unless it does very soon furnaces will have to be put out. The special iron trade is moderate, and ferro-manganese dull. Perhaps a few American orders may come along to help clear stocks. This is possible, for inquiries have already been received. The iron ore trade is, generally speaking, dull and likely to remain so until the iron trade improves. The steel departments are fairly well employed for the moment, but orders are not very plentiful except in the hoop trade, which is assured of its position.

Shipbuilding.

Practically all the Isle of Man Steam Packet Company's steamers are now at their winter quarters at Barrow, where they will undergo overhaul and repair during the winter. The Straits Settlement steamer Kedah is ready for delivery, and it will not be long before she sails for the East to take up her station. Incidentally, it may be pointed out that, when she is on service, she will be faster than the train between the ports she visits.

SHEFFIELD.

(From our own Correspondent.)

Steel Revival Rumours.

PLENTY of statements about a revival in the steel trade have been heard this week, and there is no doubt that here and there improvements have been noted. On the whole, however, business is still unsatisfactory, and many important branches are carrying on under the greatest difficulties. It is the makers of ordinary heavy steels who provide the chief obstacle to the belief that there is going to be a big improvement in trade during the next few weeks. The output from the open-hearth furnaces in the Rotherham and Stocksbridge areas has been declining for some time, and at present orders are still shrinking. In the medium and lighter classes of steels, however, there is a sense of greater activity and considerably more inquiries are about. The buying of pig iron in the Sheffield district is not making appreciable headway. Purchases are being confined to the minimum quantities, with deliveries on practically week-to-week supplies. A few contracts have been fixed up, but they are quite the exception. The pig iron market is proving anything but a profitable one, and producers are firm in their decision to refuse any further concessions. Conditions at the rolling mills are variable, and do not give any reliable index as to the way in which trade is moving. Business improves one week only to go down again the next. Sheet mills are doing a little better at the moment, but conditions are comparatively quiet at the bar, rod and strip mills. It is freely stated, however, that inquiries are coming through more readily, though orders in greater bulk would be particularly acceptable. Small orders cannot be refused, but they make economic working extremely difficult.

Steel for Electricity Scheme.

The fact that much steel work will be needed for the building of standards for the Government electricity scheme, and that Sheffield ought to have a share in the making of them, is mentioned in the monthly review of trade by the Sheffield Chamber of Commerce. This states: "Some changing of rolls and relatively small adaptations of mill gear will be needed to place the city in a position to compete with other districts. The Sheffield area has not hitherto gone in largely for heavy structural steel work, but our firms, with many of their rolling mills unemployed, will now have an excellent chance of securing many years' employment. There is the advantage of a central position as regards easily supplying structural steel standards, &c., for all the middle England schemes that will be carried out, and Sheffield will certainly have a pull over the great North of England and Scottish firms in the matter of supplying materials for the London and south country schemes."

The Lighter Trades.

The demand for tools, with the possible exception of saws and files, is on the increase, and the prospects for the winter are fairly bright. Inquiries that are coming through, not only from the home markets, but from important centres abroad, are of a very cheering character. It is also possible this week to present a more optimistic picture of the plate and cutlery trades. It has been a bad year for the majority of firms, and though September experienced some improvement, it will figure in the returns as a poor month. Now, however, a good many orders for the Christmas season trade are coming through, and some large contracts for bazaar goods of the cheaper qualities have been placed. There is an improved call for all classes of stainless steel cutlery. This week Darwins, Ltd., safety razor blade manufacturers, Templeborough, have begun re-engaging some of the employees who had to be suspended when the winding-up order was made. Nearly 1000 girls and more than 100 men were engaged on the plant at the time of the granting of the order, and heavy stocks of blades were then held. These stocks are now reported to be approaching exhaustion. The sales have not declined seriously, and the business has shown an extraordinary vitality during its recent difficulties. The announcement of the re-starting of activities has given the greatest satisfaction in Sheffield.

Pipe Contracts.

Sheffield Corporation has accepted the tender of the Staveley Coal and Iron Company, Ltd., to supply the cast iron pipes required for the trunk main from the Broomhead reservoir to the Wadsley and Moonshine service reservoirs for the sum of £54,986. The offer has also been accepted of the Stanton Ironworks Company, Ltd., to supply 200 4in. and 200 6in. concrete-lined cast iron pipes for the sum of £644. This company has also received an order for about 1500 yards 12in. concrete-lined cast iron pipes of the value of £1722 for Morley Council.

Selby Sugar Factory.

Through the operations of the Yorkshire Sugar Company, Selby has now obtained at a cost of £375,000 one of the most up-to-date sugar factories in the country. The work of erection was not started until last March, but the premises are now practically completed and will be opened this week.

NORTH OF ENGLAND.

(From our own Correspondent.)

Encouraging Iron Trade Factors.

A REDUCTION in all classes of material imported and an increase in exports are the important features of the trade of the river Tees during the past month. The statistics of imports of iron and steel are the most encouraging of any for nearly eighteen months, and reveal a welcome reduction in the importation of continental pig iron and steel. During September the total import was 20,923 tons, compared with 27,432 tons in August, and 38,611 tons in September of last year. There were reductions in the quantities of all classes of imported materials, the most substantial being a fall of 10,797 tons in the amount of pig iron. Only 3223 tons of pig iron were discharged at Tees ports during September, as against 14,020 tons in the corresponding month of last year. The successive reductions in the price of pig iron which Cleveland makers have made in the past two months are apparently beginning to have their effect in checking the import of continental material. There will, of course, still be deliveries due under old contracts, but a diminution may be looked for in the remaining months of the year, always provided there is no advance in the price of the local product. Imports of crude sheet bars, billets, blooms and slabs amounted to 12,852 tons in September, compared with 17,602 tons in the corresponding month of 1916, and 9 tons in September, 1914. Plates, bars, angles, rails, &c., accounted for 4848 tons of the total imports, compared with 6989 tons in September last year and 40 tons in the corresponding month of 1914. In the eleven months ended September 30th last the total imports of iron and steel at Tees ports amounted to the alarming figure of 354,773 tons, as against 212,869 tons in the corresponding period a year ago, and 54,563 tons in the comparable period immediately before the war.

Export Trade Expanding.

The record of iron and steel imports from the river Tees during September indicates expanding trade, although it does not reflect the improved tone which has characterised the industry during the past fortnight. Having regard to the fact that August was a holiday month, an increase in the total shipments of 7503 tons is not very large, but it is, nevertheless, a fact that more pig iron was sold in the Cleveland district last month than in any other in 1927, and as the bulk of this iron has yet to be delivered, it may fairly be assumed that the export trade of the Tees will show further improvement during the current month. It is, however, a matter for some encouragement that only once—in March last—has a bigger export of pig iron been recorded, and the aggregate shipments of pig iron, manufactured iron and steel, which totalled 95,780 tons, have only twice been exceeded this year. Coastwise shipments accounted for 20,554 tons, leaving the tonnage exported to foreign destinations at 75,226 tons, compared with 73,099 tons in August. There was a reduction of approximately 2000 tons in the tonnage of manufactured iron shipped during September, an increase of 1000 tons in the amount of pig iron shipped, and an increase of 8000 tons in the quantity of manufactured steel. An analysis of the destination of the iron and steel exported reveals that 36,764 tons out of the total of 75,266 tons went to various ports of the British Empire. India and Ceylon took by far the largest quantity, 20,444 tons; Australia coming next with 6775 tons; Tanganyika, 2745 tons; and the Cape, 2224 tons. Outside the British Empire the best customer was the Argentine, which took 15,251 tons.

Cleveland Iron Trade.

Conditions in the Cleveland pig iron trade continue to improve. Inquiries circulating are now numerous, and in some cases are for substantial quantities. Producers and merchants are in full agreement that the present gradual healthy increase of business is much preferable to anything in the nature of a boom, although rather more rapid development would be welcome. A favourable sign is that the number of blast-furnaces in blast on the North-East Coast is to be increased from thirty-nine to forty-one. Gjers, Mills and Co., Ltd., Middlesbrough have decided to restart their Ayresome Ironworks, which have been closed down since May last. Two of the firm's three blast-furnaces are to be put into operation again, one on the manufacture of hematite and the other on the production of ferro-silicon. Pig iron prices are unchanged, No. 1 Cleveland foundry being 70s.; No. 3 G.M.B., 67s. 6d.; No. 4 foundry, 66s. 6d.; and No. 4 forge, 66s., all for home use. Ironmasters' fixed quotations for dispatch to Scotland and to destinations abroad are 2s. 6d. below the foregoing figures.

Hematite Pig Iron.

The small output of East Coast hematite iron is hardly sufficient to cover market needs, but producers are keen to liquidate their still rather heavy stocks. Fairly numerous continental inquiries for special qualities of hematite have resulted in a few contracts being arranged. Mixed numbers are offered at 74s. to 75s., both for home use and export, No. 1 quality being at a premium of 6d. per ton.

Ironmaking Materials.

Consumers of foreign ore are so well placed as regards supplies that merchants are unable to put through business. Delayed deliveries, to suit the convenience of users, are stated to be somewhat large, and stocks are still considerable. Market rates remain nominal on the basis of best Rubio at 21s. per ton c.i.f. Tees. Buyers of Durham blast-furnace coke are still seeking price concessions, notwithstanding producers' threat to put ovens out of operation rather than lower further already unprofitable quotations. Good medium kinds are offered at 18s. per ton delivered at the works.

Manufactured Iron and Steel.

The feature of the manufactured iron and steel trade is the increasing demand for shipbuilding materials, and some large orders have recently been placed. Most of the builders are taking advantage of the rebate scheme. Orders for other constructional material are also coming forward more freely. Prices are unchanged.

The Coal Trade.

The Northern coal trade prospects are discouraging. There is a pronounced lack of new business for the last quarter of the year, and fitters of every grade admit having to face an anxious time, and with every prospect of having further to reduce production. For this month only in one or two cases are the owners well booked, practically all seeking trade, even at the present low ruling prices. Contractors are being pressed to take out maximum commitments, and to do so are in most cases having to face heavy losses, owing to the low current prices as compared with old contract values. Northumberland steam coals find a very slow general inquiry, and the low prices do not appear to have any attraction for con-

tinental buyers. Good ordinary kinds are readily obtainable direct at 13s. 6d. to 14s., but through other holders these prices can be discounted. Best Durham steams are also feeling a want of trade, and are plentifully offered; large at 15s. 6d. to 16s. and smalls, 11s. 6d. to 12s. Durham gas coals have moderate prospects. Superior grades are offered at 15s. 6d. to 16s., and secondary qualities at 13s. 3d. to 14s. Bunker coals are in slow request, both for the coaling stations and the ordinary bunker trade, and are in good supply at 13s. 6d. to 13s. 9d. for good ordinary and 14s. to 15s. for best and specials. Contrasted with the general dullness in the coal market, the coke section is particularly brisk. Gas makes are well sold through the current month at 20s. 6d. to 21s., and beehive sorts are scarce at 25s. to 30s. Ordinary patent foundry is meeting with better inquiry, but supplies are large at 17s. 6d. to 18s. 6d., while superior grades are 24s. to 26s. The only dull department is that concerned with blast-furnace descriptions, which are offered at 18s., delivered at the works.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding: Large Output.

THE amount of tonnage launched from Clyde shipyards during September was the largest for any month this year to date. Seventeen vessels of 57,119 tons aggregate were launched, and the next highest total this year was the return for June of twenty-eight vessels of 40,466 tons aggregate. By virtue of the September returns the figures for this year to date show a gain of 17,000 tons aggregate over the same period in 1926. There is a moderate amount of work in hand at the various yards and a fair measure of activity may be observed throughout the winter months. A considerable portion of the work now being completed relates, however, to contracts held up last year. New orders are still comparatively scarce, and in this respect the outlook is none too promising. Costs are yet too high to attract owners, and not only has the number of vessels decreased, but the average size is also smaller compared with pre-war days. Included in the list of vessels launched during September were the following:—Beaverburn, twin-screw turbine, 10,000 tons, for the Canadian Pacific Steamships, Ltd., Montreal; Pacific Enterprise, twin-screw motor ship, 6750 tons, for the Norfolk and North American Steam Shipping Company, Ltd., London; Planter, cargo, 5900 tons, for Messrs. T. and J. Harrison, Liverpool; Vimeira, oil tanker, 5700 tons, for Messrs. Gow, Harrison and Co., Glasgow; Itaquice, twin-screw motor ship, 5000 tons, for the Companhia Nacional de Nevegaces Costeira, Rio de Janeiro; and the Uganda, cargo, 4950 tons, for Maclay and MacIntyre, Ltd., Glasgow. Contracts announced during September included those for three cargo steamers, one of 7400 tons, one of 7000 tons and one of 6000 tons, and a number of smaller craft.

Steel.

Conditions in the steel trade still fail to show any definite improvement. Some materials are a shade busier, but on the whole the demand is only moderate and the majority of the works are engaged below capacity. Orders are required for most descriptions of material, including boiler plates, which have not received benefit from the recent cut in prices. Light steel sheets have been somewhat busier, owing to buying on Indian account, but heavy sheets remain unsatisfactory. Tube makers are fairly busy. Prices are unchanged.

Iron.

The amount of business being done in bar iron continues on a restricted basis. The home price is unchanged, but export orders can be placed on more advantageous terms from a buyer's point of view. Re-rolled steel bars have received little, if any, benefit from the reduction in quotations, and plants are indifferently employed.

Pig Iron.

The demand for pig iron has not expanded, and, despite reduced outputs, stocks are still increasing. In all probability a further reduction in outputs will be resorted to. Prices are weak.

Exports and Imports.

About 5000 tons of manufactured iron were shipped from Glasgow during the past week, that figure including the largest quantity shipped to Montreal this season. Australia, India, South Africa, China, Japan, and New Zealand were the other destinations. Imports of iron ore amounted to 5200 tons; 1300 tons of manufactured iron products from the Continent, 400 tons of billets from Germany, and 1100 tons of iron plates were discharged.

Coal.

The position of the coal market still reflects the dearth of shipping orders. Supplies of most fuels are ample, and shipping qualities are offering in considerable quantities at comparatively cheap prices. Best house coal is the only fuel to show improvement in turnover. Industrial fuels are inactive, but gas and electricity concerns are now taking better deliveries. Aggregate shipments amounted to 248,043 tons against 252,559 tons in the preceding week, and 245,817 tons in the same week in 1925.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THE general state of trade has again been very disappointing. In some directions there has been a little more activity, but it has been counterbalanced by a decline in others, so that on the whole there has been no appreciable improvement. Last week coal exports registered a falling off, as the total came to only slightly over 401,700 tons, whereas in the previous week the total was over 438,000 tons, and in the week prior to that the quantity was over 523,000 tons. The fact that shipments were so much lower is not surprising when it is borne in mind that the number of idle loading appliances at the various docks last week ran to as many as forty-five and even fifty, which means that not only must there have been considerable unemployment at the docks, but also in the coalfield. Standing stocks of coal were very heavy, and it is reported that in the case of one important undertaking they had just over 5000 trucks of loaded coal awaiting outlet for shipment, which means at least 50,000 tons of standing coals. In such circumstances it will be realised that the market for large coals especially can have very little stability, and that salesmen have great difficulty in maintaining even recent figures. Unfortunately, the depression is compelling owners to serve notices to an increased number of workmen, as it has become necessary to close down additional collieries for an indefinite period, among them being pits belonging to the Ebbw Vale Company near Abertillery. The news from the Continent is not good, inasmuch as the Vice-consul at Cardiff for Belgium has stated that, although he has no official news, he is aware that Belgium contemplates following the lead of France and Spain in instituting restrictions upon the use and consumption of foreign coal, and that a committee is now considering the matter. It is true that Belgium imports considerably more coal from the North-East Coast ports than from South Wales, but still the quantity from this district is approximately a quarter of a million tons per annum, and in the present state of trade a further contraction in exports will be seriously felt. In the case of Spain, it is to be noted that the restrictions which apply to the importation and use of coal have now been made to apply also to coke.

Coalowners' Action.

The gravity of the position in South Wales is fully realised by the coalowners. Last week there was a very important meeting of representatives of colliery undertakings, especially the eastern area of the coalfield, when it was decided to notify the Great Western Railway Company of the strong objection to the new railway rates which came into operation as from the 1st inst. It is stated that to more than one undertaking the proposed increase means an additional burden of over £10,000 per annum. It is understood that the whole matter is to be brought before the Railway Rates Tribunal at the earliest possible moment. The subject also came before members of the Coal Freighters' Association at a meeting at Cardiff at the end of last week, when representatives of companies with a combined output of over 34 million tons per annum attended, and the action of the coalowners was supported. Not only are the coalowners moving regarding the question of railway rates and dock charges, but the Commercial Committee of the South Wales Coalowners' Association is engaged upon a scheme dealing with the question of output and price control. Mr. Finlay Gibson, who is the secretary of the Coalowners' Association, has stated that this Commercial Committee has had under consideration for some time past proposed schemes to meet the existing conditions in the coal trade, but he could not divulge the details until the matter has reached a more definite stage, and the Commercial Committee has a definite scheme to lay before the general body of the Association. It is understood, however, that several proposals have been under discussion relative to the partial regulation of production, an arrangement respecting minimum prices for grouped collieries, and the compensation of undertakings.

G.W.R. Returns of Traffic.

The details of traffic at the docks under the control of the Great Western Railway Company in South Wales show that for the four weeks to September 4th last imports and exports came to a total of 2,829,632 tons, which compared with a total of 608,789 tons for the four weeks ended September 5th of last year, when the national coal stoppage was in progress. Taking the whole of this year to September 4th last, the quantity of imports and exports aggregated 21,819,532 tons, which compares with 11,976,156 tons for the same period of last year, and 24,110,836 tons for the same period of 1925.

Tin-plate Industry.

There was a resumption of work by several hundred employees in the steel and tin-plate trade in the Swansea area on Monday last, a restart being made at eleven mills at Baldwin's King's Dock Works. Hopes are entertained that work will proceed steadily now for several weeks at least. It is understood, however, that owing to the general depression which prevails in the industry, the men's leaders have decided not to press forward their proposed superannuation scheme, and that the time is not regarded as opportune for pursuing discussions relative to the revision of the sliding scale agreement.

New Industry Foreshadowed.

Considerable interest is displayed in the activities of a new company foreshadowed by the registration of "Swansea Residues, Ltd.," a private undertaking with a nominal capital of £35,000, with Lord Glenconner as chairman. It is understood that the promoters are interested in the extraction of the residues of spelter slag, and that they intend to establish works adjacent to the old Dillwyn Spelter Works at Llansamlet, where there are spelter dumps estimated at between one and two million tons. These dumps, however, are small compared with those of other spelter works in the Swansea area. The process of treatment to be adopted by this new concern has not been made public, but hopes are entertained that an extensive new industry will spring up.

Current Business.

The general tone of the steam coal market has been very dull during the past week. Very little fresh inquiry is coming along, and shipments are very slow. Prices of some descriptions of large are a shade easier, while even smalls have lost some of their steadiness, owing to the falling off in the demand. The market generally displays no feature. Patent fuel and coke remain unchanged, and orders are very limited, but pitwood is firm and scarce, for although collieries require much reduced supplies as compared with more active times, the amount of pitwood coming forward is substantially restricted.

LAUNCHES AND TRIAL TRIPS.

BRITISH UNION, oil tank motor vessel; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the British Tanker Company, Ltd.; dimensions, 454ft. by 57ft. Engines, six-cylinder Wallsend-Sulzer oil; constructed by the Wallsend Slipway and Engineering Company, Ltd.; launch, September 26th.

ARAGUA, twin-screw oil tank steamer; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of the Venezuela Gulf Oil Company; trial trip, September 28th.

BEAVERDALE, twin-screw turbine steamer; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of the Canadian Pacific Steamships, Ltd.; dimensions, 495ft. by 61ft. 6in. by 40ft. 6in.; 10,500 tons deadweight. Engines, twin-screw, single reduction, geared turbines, pressure 250 lb.; constructed by the Parsons Marine Steam Turbine Company, Ltd.; launch, September 28th.

CHRISTIAAN HUYGENS, motor mail ship; built by the Netherland Shipbuilding Company, to the order of the Stoomvaart Maatschappij "Nederland;" dimensions, 570ft. by 68ft. 6in. by 39ft. 9in. Engines, twin-screw Sulzer engines; constructed by Werkspoor, Amsterdam; launch, September 28th.

KING EDWIN, motor cargo vessel; built by Harland and Wolff, Ltd., to the order of the King Line, Ltd.; dimensions, 400ft. by 54ft. 6in. by 34ft. 8in.; 5130 gross tonnage. Engines, six-cylinder, four-cycle, single-acting Diesel; constructed by the builders; launch, September 29th.

UGANDA, cargo steamer; built by D. and W. Henderson and Co., Ltd., to the order of Maclay and McIntyre, Glasgow; dimensions, 403ft. by 52ft. by 29ft. 10in.; 4950 gross tonnage. Engines, triple-expansion, 25in., 41in., and 68in. by 51in. stroke, pressure 180 lb.; constructed by the builders; launch, September 29th.

ROVUMA, shelter deck steamer; built by Ardrossan Dockyard, Ltd., to the order of the Union-Castle Mail Steamship Company, Ltd.; dimensions, 211ft. by 35ft. by 21ft.; 1289 gross tonnage. Engines, two sets of triple-expansion, surface condensing, 11½in., 18½in., and 31in. with 21in. stroke, pressure 180 lb.; constructed by W. Beardmore and Co., Ltd.; trial trip, September 30th.

CONTRACTS.

WILLIAM BEARDMORE AND Co., Ltd., of Dalmuir, are engaged upon an order for twenty-five six-wheels-coupled side tank goods engines for the London, Midland and Scottish Railway. The engines are to the designs of Sir Henry Fowler, chief mechanical engineer.

SIEMENS BROTHERS AND Co., Ltd., of Woolwich, ask us to announce that a new central battery telephone exchange of their manufacture was brought into service at Govan, Glasgow, on Saturday, the 17th ult. The new switchboard has thirteen operators' positions and is equipped for 700 subscribers, with an ultimate capacity of 2000.

THE LEA RECORDER COMPANY, Ltd., has recently received repeat orders for:—(*a*) Boiler-feed and condensate recorders for the Wallasey, Southport, Exeter and Kettering Elec. Works, from the South Metropolitan Gas Company, Pilkington Brothers, Brunner Mond and Co., and a repeat order for seventeen boiler-feed recorders for one of the large textile combines; (*b*) for coal meters for Bristol Elec. Works (10), for Athens Elec. Works (18), and for Singapore Elec. Works (12), as well as for others from Japan, Australia, India and South America. The same firm has also received repeat orders for instruments from various electricity works, including those at Torquay, Croydon, Preston, Aberdeen, Cardiff, City of London Elec., Newcastle Elec. Supply, County of London Electric Supply, &c.

CROMPTON PARKINSON, Ltd., has recently received orders from abroad for:—(*a*) The equipment of the Allahabad Power Station with two rotary converters, 6-phase, reversible, each of 400 kW, also one of 200 kW, together with the necessary starting equipment; (*b*) turbo-alternators and four oil engine driven alternators for New South Wales; (*c*) five large auto-synchronous motors for pump drives for the Bunnerong Power Station, New South Wales; (*d*) nineteen 125 H.P., 245 r.p.m., and nineteen 80 H.P. pipe-ventilated slip-ring motors; (*e*) three drip-proof auto-synchronous machines for Johannesburg; (*f*) two drip-proof motors of 105 H.P., 415 volt, 50-cycle, 3-phase, for Southern Malayan Tin Dredging, Ltd.; (*g*) an extension of the equipment of the Egyptian Sugar Refining Company at Alexandria, consisting of three 175 kW C.C. generators; (*h*) auto-synchronous motors for Singapore, Perth, Western Australia, New Zealand, and Vishnu.

RANSOMES AND RAPIER, Ltd., of Ipswich, have recently secured orders for Ransomes-Rapier Marion excavators from Standard Portland Cement Company, of Sydney; F. W. Moore and Co., Ltd., Adelaide; the Southern Cement Company, Sydney; and from the New South Wales Government Railways. The same firm has also received orders for petrol-electric mobile cranes from the Yellow Express Carriers, Ltd., Sydney, Australia; the National Elec. and Engineering Company, Ltd., Wellington, New Zealand; and from the Municipality of Singapore; and for hydraulic buffer stops from the Buenos Aires Gt. Southern Railway (16 pairs); and from the India Office (8 pairs). It is interesting to note that fourteen of the buffer stops in hand for the Buenos Aires Great Southern Railway, which are designed to stop a train of 1000 tons travelling at 12 miles per hour, are the largest hydraulic buffer stops constructed by the firm up to the present.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. J. LLOYD BENTLEY, who had been with Dorman, Long and Co., Ltd., for the last seven years, has been appointed works manager in general charge of the iron and steel works in Staffordshire of Robert Heath and Low Moor, Ltd.

STAINLESS IRON AND ALLOYS COMPANY, Ltd., of Blackfriars-street, Manchester, informs us that the Vereinigte Stahlwerke and Messrs. Krupp have taken up the English patents for the manufacture of rustless steel by the Hamilton and Evans open-hearth process.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	21/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 16 0	—
No. 1 Foundry	3 19 0	—
No. 3 Foundry	3 14 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 15 0	3 15 0
No. 1	3 15 6	3 15 6
Cleveland—		
No. 1	3 10 0	3 7 6
Silicious Iron	3 10 0	3 7 6
No. 3 G.M.B.	3 7 6	3 5 0
No. 4 Foundry	3 6 6	3 4 0
No. 4 Forge	3 6 0	3 3 6
Mottled	3 5 6	3 3 0
White	3 5 6	3 3 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
" " Foundry	3 5 0 to 3 6 0	
(3) Northampton—		
Foundry No. 3	3 1 0	—
Forge	2 17 0	—
(3) Derbyshire—		
No. 3 Foundry	3 5 0	—
Forge	3 3 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 4 0 to 3 5 0	
No. 4 Forge	3 2 6	—
Basic	3 2 6	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 7 6 (a); 4 10 6 (b); 4 14 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 15 0	10 10 0
Best	—	
N.E. Coast—		
Iron Rivets	11 15 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	12 10 0	—
S. Yorks.—		
Crown Bars	11 0 0	—
Best Bars	12 5 0	—
Hoops	12 10 0	—
Midlands—		
Crown Bars	9 10 0 to 10 0 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	
Gas Tube Strip	11 17 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¼in. and up	8 2 6	7 12 6
Sections	7 12 6	7 2 6
Steel Sheets, ¼in.	9 0 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	14 5 0	£14 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	
Billets	7 10 0 to 10 0 0	
Manchester—		
Bars (Round)	8 10 0	—
" (Small Round)	7 15 0	—
Hoops (Baling)	10 5 0	10 0 0
" (Soft Steel)	9 0 0	8 15 0
Plates	8 7 6	—
" (Lancs. Boiler)	11 0 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 12 6 to 8 2 6	
Intermediate Basic	7 10 0	—
Soft Basic	7 5 0	—
Hoops	10 0 0 to 10 10 0	
Soft Wire Rods	9 0 0	—
Midlands—		
Small Rolled Bars	7 15 0 to 8 0 0	
Billets and Sheet Bars	6 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	13 17 6 to 14 0 0	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/- to 18/3
Block Tin (cash)	£69 5 0
" (three months)	£66 15 0
Copper (cash)	£53 18 9
" (three months)	£54 5 0
Spanish Lead (cash)	£20 5 0
" (three months)	£20 18 9
Spelter (cash)	£26 12 6
" (three months)	£26 10 0
Manchester—	
Copper, Best Selected Ingots	£61 17 6
" Electrolytic	£62 10 0
" Strong Sheets	£66 0 0
" Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price), lb.	0 0 11½
" Condenser, lb.	0 1 1½
Lead, English	£22 0 0
" Foreign	£21 0 0
Spelter	£26 10 0
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
" " 6 p.c. to 8 p.c. "	£22 17 6	7/3
" " 8 p.c. to 10 p.c. "	£22 10 0	6/6
" " Specially Refined		
" Max. 2 p.c. carbon	£36 0 0	11/6
" " " 1 p.c. "	£41 10 0	15/-
" " " 0·70 p.c. carbon	£53 0 0	17/6
" " " carbon free	1/4½ per lb.	
Metallic Chromium	3/- per lb.	
Ferro Manganese (per ton)	£12 0 0 for home, £16 for export	
" Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/- per unit	
" " 75 p.c.	£20 5 0 scale 6/- per unit	
" Vanadium	14/3 per lb.	
" Molybdenum	5/- per lb.	
" Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	12/9
" " Ell	13/3
" " Splint	14/6 to 15/6
" " Trebles	14/- to 14/6
" " Doubles	13/- to 13/3
" " Singles	12/-
Ayrshire—	
(f.o.b. Ports)—Steam	13/-
" " Jewel	15/6
" " Trebles	14/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	11/6 to 12/9
Screened Navigation	18/-
Trebles	15/- to 16/6
Doubles	13/3
Singles	12/6
Lothians—	
(f.o.b. Leith)—Best Steam	12/6
Secondary Steam	12/-
Trebles	14/- to 15/-
Doubles	13/3
Singles	12/3

ENGLAND.

	Inland.
(8) N.W. Coast—	
Steams	24/- to 25/-
Household	40/- to 56/-
Coke	22/6 to 23/-
Northumberland—	
Best Steams	13/6 to 14/-
Second Steams	13/-
Steam Smalls	10/6
Unscreened	13/- to 13/6
Household	21/- to 27/-
Durham—	
Best Gas	16/-
Second	13/9 to 14/-
Household	21/- to 27/-
Foundry Coke	19/- to 26/-
Sheffield—	
Best Hand-picked Branch	28/- to 30/-
Best Selected House Coal	22/6 to 23/-
Screened House Coal	19/- to 20/-
" " Nuts	16/- to 17/6
Yorkshire Hards	14/6 to 16/6
Derbyshire Hards	15/- to 17/-
Rough Slacks	9/- to 10/-
Nutty Slacks	7/- to 8/-
Smalls	3/- to 4/6
Blast-furnace Coke (Inland)	14/- to 14/6 at ovens
" " (Export) f.o.b.	18/6 to 19/-

(9) SOUTH WALES.

	Export.
Cardiff—	
Steam Coals:	
Best Smokeless Large	19/9 to 20/3
Second Smokeless Large	19/- to 19/6
Best Dry Large	18/6 to 19/-
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/- to 18/3
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/6 to 17/9
Ordinary Eastern Valley Large	17/- to 17/6
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	12/- to 13/6
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	19/6 to 20/-
" " Smalls	15/6 to 16/-
No. 2 " Large	17/- to 17/6
" " Through	15/6 to 16/-
" " Smalls	13/- to 14/-
Foundry Coke (export)	35/- to 40/-
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	23/6 to 24/6
Pitwood (ex ship)	33/- to 33/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	34/- to 36/-
Seconds	28/- to 32/6
Red Vein	24/6 to 27/6
Machine-made Cobbles	37/6 to 42/6
Nuts	42/6 to 46/-
Beans	27/6 to 30/-
Peas	18/6 to 20/-
Breaker Duff	8/6 to 9/-
Rubbly Culm	9/- to 9/6
Steam Coals:	
Large	18/6 to 19/6
Seconds	17/6 to 18/-
Smalls	10/6 to 12/-
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 7/6 joists and 5/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

The Steel Cartel.

In the belief that iron and steel prices have now reached an absolute minimum, there is some expectation that consumers will soon begin to replenish stocks, which must have been getting less for some months past, but while the situation is no worse than it was recently, it cannot be said that there is yet any definite sign of improvement. Meanwhile, efforts continue to be made to organise the steel industry, and at the meetings of the Steel Cartel, which have just been held in Luxemburg, it was decided to maintain the production during the last quarter of the year, contrary to the general expectation that it would be necessary to provide for the smaller consumption by reducing output. Germany, however, was opposed to any reduction on account of the activity of her own consuming industries, and she secured an amendment of the penalty clause for exceeding the allotted quota, which is now one dollar a ton in excess instead of two dollars. The negotiations for the admission of Poland into the International Union, as the Cartel is now more generally called, have made little headway, for the Union will only allow Poland an annual quota for export of 300,000 tons, while that country insists upon 500,000 tons, and at the same time it is desired to restrict the Polish production. Efforts continue to be made to create international sales organisations for rolled iron and steel, and the difficulties which have delayed the formation of the girder *comptoir* on account of the claims of Belgium seem likely to be overcome by the offer of Germany to make over to Belgium 20,000 tons of her own quota on condition that Belgian girder firms undertake not to export to Germany. It is hoped that a final arrangement will be come to at a forthcoming meeting in Brussels. The negotiations for the wire rod cartel are still proceeding laboriously, and it has been impossible, so far, to arrive at a compromise.

The Production of Electricity.

A report upon the distribution of electricity in and around Paris last year states that the three companies, owning five generating stations at Saint-Ouen, Issy-les-Moulineaux, Gennevilliers, Vitry and Saint-Denis, produced in 1926 a total of 1572 million kilowatt-hours. In 1925 the production was 1401 million kilowatt-hours, and in 1924 1254 million kilowatt-hours. Notwithstanding the small rate of increase last year, chiefly on account of the declining industrial activity, the companies are looking forward to a considerable development of consumption for domestic purposes, and for some time past extensions to the various generating stations have been in progress, while at Ivry a new station of 200,000 kW is being constructed, and the Union d'Electricité has decided to create a station of 400,000 kW capacity at Vitry.

Railway Construction.

As part of a scheme for transforming the existing narrow gauge railways between Nice and Draguignan, Digne and other places into normal gauge lines if investigation show that the economy of the project justifies the expense, a proposal is now under consideration for the construction of a line between Avignon and Nice, whereby the distance between the two towns will be reduced by 52 miles. At first it was proposed to carry the line through Salon, Aix-en-Provence and Brignoles, and to join it up with the Marseilles-Nice Railway, but preference is now given to a route which will utilise the existing double normal-gauge line between Avignon, Miramas and Cheval-Blanc. From this latter place the single normal-gauge line will be doubled to Pertuis, whence a new railway will be built to Arcs. The railway will probably be electrified. Apart from the advantage of shortening the route to Nice the new railway will pass through a district containing considerable bauxite deposits which cannot at present be properly developed on account of lack of transport facilities.

Flood Protection.

So much damage is caused by the inundations of the Isère Valley through the bed of the river steadily rising as the result of the accumulation of rocks brought down by the mountain torrents that the Government appointed a commission to investigate the means of obviating the danger. A competition was opened and a dozen schemes were received, some for raising the banks and constructing drainage canals and others for removing obstructions in the river and the cutting of bends in the belief that the current will deepen the bed. One goes so far as to propose dredging the river and crushing the rocks sufficiently to allow of their being carried away by the current when returned to the river. The Commission, however, is interested particularly in some of the schemes presented for utilising the Isère in such a way for the production of electrical energy that it will prevent any risk of the river overflowing the banks, although much of the trouble is caused by the infiltration of water through the banks which have had to be raised as a protection.

Utilisation of Peat.

A congress on the utilisation of peat which has been held at Laon, attracted a good deal of attention on account of the considerable reserves of fuel that would help to reduce the expenditure on foreign coal if only means could be found of drying it rapidly and economically. The peat industry is at present limited to local needs, and it cannot develop further until cheaper methods are introduced for dessicating the peat on a large scale, and although a good deal of general information was given at the Congress, nothing practical was forthcoming beyond a panegyric of a certain process for granulating peat for which an experimental works is being installed near Laon. The process is complicated, and its value must depend upon the economy of the system as represented by the cost of the by-products, which are of more importance than the fuel value of the peat itself.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

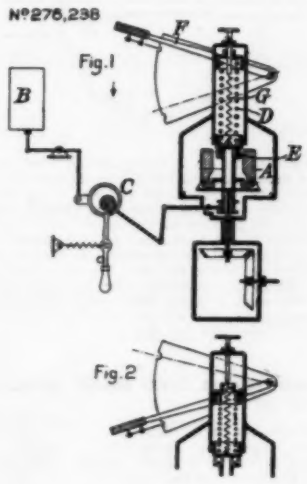
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

276,238. February 16th, 1927.—GOVERNING MARINE DIESEL ENGINES, Motorenfabrik Deutz Aktiengesellschaft, Köln-Deutz, Germany.

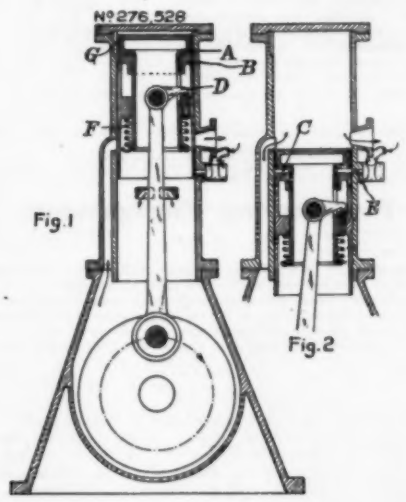
This governor is intended to provide two regions of automatic control, one at the highest permissible speed and the other at the lowest speed consistent with the engine continuing to fire, with an intermediate region of hand control. The governor weights A are of the usual centrifugal type and are driven



by the engine through the gearing shown. They act on the fuel pump B through the double excentric C. By manipulating this excentric through the handle shown the stroke can be varied and the speed controlled manually. The governor weights act in opposition to the spring D, which does not rotate, as there is a ball bearing at E. The tension of this spring can be set, by means of the lever F, for slow running as in Fig. 1 or for full speed as in Fig. 2. The spring G balances the weight of the running parts.—*August 25th*, 1927.

276,528. November 4th, 1926.—A DIESEL MOTOR CAR ENGINE, F. Cockerell, Feilitzchstrasse 2A, München, Germany.

It is claimed that this engine is suitable for motor car work, as it is light and can be run at speeds of from 3000 to 4000 r.p.m. Its peculiarity lies in the piston, which in two pieces A and B that slide one within the other in such a manner as to provide a



cavity C. The sliding is effected by the projection D on the connecting-rod. When the piston is at the bottom of its stroke —see Fig. 2—the cavity comes opposite the fuel inlet port E and is filled with fuel. At the top of the stroke the cavity is closed up by the spring F, and the fuel is transferred to the combustion space by the port G.—*September 1st*, 1927.

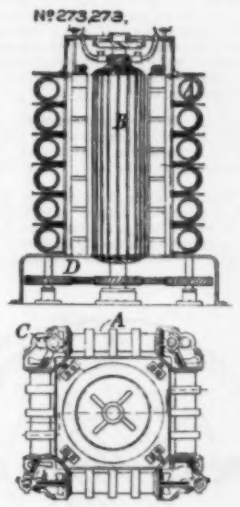
260,259. October 19th, 1926.—IMPROVEMENTS IN OR RELATING TO WIRELESS TELEGRAPHY AND TELEPHONY, Telefunken Gesellschaft fur drahtlose Telegraphie m.b.H., of 9, Tempelhofer Ufer, Berlin, and of 12, Hallesches Ufer, Berlin, S.W. 11, Germany.

In hitherto known aerial arrangements, the construction is such that radiation is not of equal strength in all directions. With a vertical aerial of the usual type, energised at its fundamental frequency, the strongest radiation takes place in the equatorial plane, and substantially no radiation takes place in direction of the antenna itself. For space radiation—i.e., for transmitting energy into the higher layers of the atmosphere—it has been proposed to energise vertical aerials on their harmonics, so that a maximum radiation takes place at an upward angle. It has also been proposed to determine the direction of radiation of short waves by mirror arrangements. It has been found, however, that methods hitherto employed, in which the radiation was given a predetermined direction or angle of direction, are not suitable for communication with waves of about 20 m. According to this invention, a transmitting or receiving aerial system is so arranged that radiation of energy at the transmitting station takes place in quick succession in all directions, the signals at the receiving station being received strongly from all directions. In one form of construction, according to the invention, an aerial system comprises a number of rod shaped antennæ, energised at or near their mid points, each arranged as a diameter of a sphere and pointing in different directions, so that the half length of each antenna passes out in a radial direction from a centre. A series of aerials may be arranged in star shape in one plane. A frame made according to the invention comprises several aerials arranged so as to form a star-like figure in one plane, the plane being preferably inclined to the horizontal. The most general case is that in which many star-shaped or compass card aerial systems in several intersecting planes are employed. The arrangements possess the advantage that radiation from the transmitter does not proceed in any one direction. The waves from the transmitting station to the receiving station consist of oscillations polarised in different planes. Variations of intensity at the receiving station which depend upon the temporary physical relations of the layers of the atmosphere are thus diminished. At the receiving end it is desirable to employ a corresponding aerial system, in which all aerials are connected to a common receiver in order to lead energy of the incoming oscillations coming from different directions to the receiver. The individual aerials at the transmitter end are energised successively in very rapid alternation.—*September 8th*, 1927.

DYNAMOS AND MOTORS.

273,273. June 9th, 1927.—IMPROVEMENTS IN OR RELATING TO ELECTRIC POWER GENERATING PLANT, *Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, Westminster.*

The electric generating plant described in this specification is built on very unorthodox lines. Power cylinders A of the opposed-piston type are arranged around an electric generator

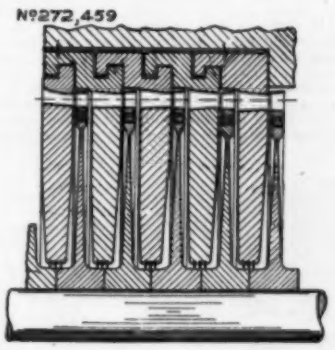


B. In the case illustrated, four of these cylinders form a square and six sets of these cylinders are mounted one above the other, so that in all there are twenty-four cylinders. Crank shafts C are provided at the corners of the engine, and they are coupled together and drive the generator through gearing in the space D. —*September 1st*, 1927.

TURBINE MACHINERY.

272,450. April 14th, 1927.—IMPULSE STEAM TURBINES, Aktiengesellschaft der Machinenfabriken Escher Wyss et Cie., 19, Hardturmstrasse, Zurich, Switzerland.

The object of this invention is to prevent the buckling of the guide discs when they have radial clearance in the turbine



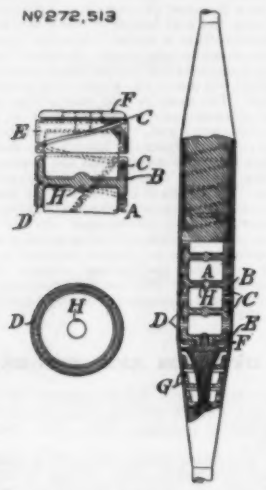
casing. Each disc, it will be seen, is provided with a hook-shaped annular extension, which interlocks it with its neighbour, so that the discs support one another. It is claimed that the arrangement also has the advantage that the leakage of steam into the clearance space is prevented.—*September 1st*, 1927.

TELEGRAPHS AND TELEPHONES.

272,513. June 8th, 1927.—PROTECTION OF LOADING COILS IN SUBMARINE CABLES AGAINST PRESSURE, International General Electric Company, of 120, Broadway, New York, U.S.A.

When loading coils are inserted in submarine cables, they must be protected against the high water pressure without spoiling the flexibility of the joint, and according to this invention high resistance to compression and flexibility of the cable at the coil are secured without unduly increasing the diameter. The coils or groups of coils indicated at A are situated between links B, which consist of a disc with a rim. In the rims there are helical grooves C, which serve to take the tension wire that

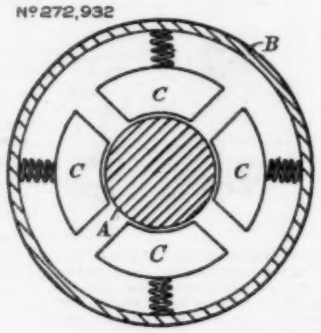
holds the links together. A second group of grooves D on the rim serve to take the conductors of the cable, and these grooves also extend around the edges of the rim towards the inside and serve for the protection of the conductors leading to the coils. The two last links of the joint are constructed as shown at E, and the end of the tension wire is securely clamped to both ends



of the joint by means of the disc F. The links G serve for the gradual change over of the diameter of the joint to the diameter of the cable. The discs of the individual links are provided with a spherical bulge H, which serves for centring and holding the coils or groups of coils A. With this form of construction the coils retain their correct position, even when the joint is bent.—*September 1st*, 1927.

272,932. June 15th, 1927.—Improvements in or relating to Dynamo-electric Machines for use in connection with Radio Apparatus, Telefunken Gesellschaft für drahtlose Telegraphie m.b.H., 9, Tempelhofer Ufer, Berlin, Germany.

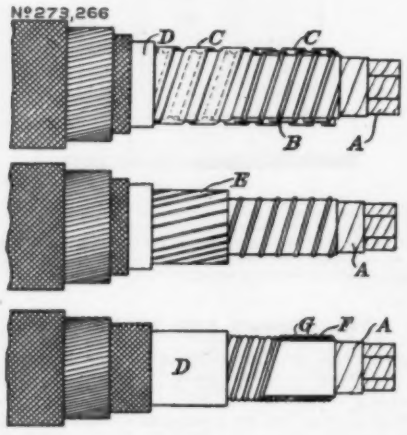
According to this invention the power for valve transmitters is derived from a generator driven by a motor, and the two machines are coupled in such a manner that fluctuations in the speed of the motor cause considerably smaller fluctuations in the generator voltage. A suitable form of coupling is shown in the



accompanying illustration in which A is the disc secured to the motor shaft and B a drum secured to the generator shaft. Weights C are pressed by means of springs against the motor disc. The motor runs at a higher speed than the generator; in other words, there is a slip. By suitably selecting the size of the weights C and the strength of the springs, the desired result can be obtained, experience having shown that the arrangement enables motor speed fluctuations in the region of ±30 per cent. to cause fluctuations in the generator potential of barely 1 per cent.—*September 1st*, 1927.

273,266. May 31st, 1927.—Improvements in or relating to Electric Cables having a Supported Lead Sheath, Siemens-Schuckertwerke Gesellschaft mit beschränkter Haftung, of Berlin-Siemensstadt, Germany.

The lead sheaths of cables laid in great depths of water are exposed to a considerable pressure stress on account of the water pressure, and this specification describes a cable with a supported lead sheath. In the drawing three alternative forms

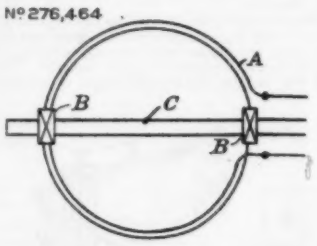


of construction are shown. Referring first to the upper illustration, A is the jute insulation placed over the core, with a supporting spiral B with two layers of metal band C placed over the latter, so that the spirals of the band overlap each other. D is the lead sheath. In the middle illustration flat wires E are used instead of the metal band winding. The lower drawing shows a cable with a flexible metal tube F, and the gaps are filled by wires G.—*September 1st*, 1927.

MEASURING AND TESTING INSTRUMENTS.

276,464. June 15th, 1926.—Improvements relating to Electrical Resistances, Siemens Brothers and Co., Ltd., of Caxton House, Tothill-street, London, S.W. 1, and Leslie Gordon Salmon, of Siemens Brothers and Co., Ltd., Bowater-road, Woolwich, S.E. 18.

The resistances described in this specification are intended mainly for the measurement of temperatures. In connection with temperature measurement, sensitivity and response to change of temperature and constancy of resistance for a particular temperature are of paramount importance, and with the present methods of construction the desired sensitivity and constancy are difficult to obtain. According to this invention,

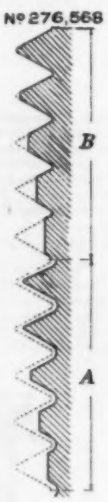


the resistance element of a resistance electrical thermometer is formed of unconfined insulated wire supported so that it is free to contract and expand, and the wire is not as a whole in contact with any solid material. Six different schemes are described, and the drawing shows one of them. The insulated wire A is wound in loop formation, and the loops are attached to insulating supports B, one of which is fixed to the stem C, the other being free to slide on the rod. The coiled wire A is therefore free to expand or contract. The individual layers of the coil A may be woven in basket formation or they may be angularly displaced, giving rise to a globular formation of the resistance element.—*September 1st*, 1927.

MACHINE TOOLS AND SHOP APPLIANCES.

276,568. February 17th, 1927.—Cutting Internal Screw Threads, A. Fecke, 3, Klewergarten, Hannover-Linden, Germany, and Hannoversche Maschinenbau-Actien-Gesellschaft vormals Georg Egestorff (Hanomag), 1, Hamelnerstrasse, Hannover-Linden.

This tap has two stages of cutters, the preliminary one of which leaves a surplus of metal over the whole screw thread profile, due to the fact that the core diameters of all the cutters of this stage are less than the diameter of the bore in which the thread is made, and those diameters are uniform throughout. The flank angles of the cutters of the first stage correspond to those of the theoretical screw thread and the thickness of the cutters is uniform, so that there results an unfinished thread with smooth walls. In the drawing the preliminary cutters are indicated by A, while the finishing part is marked B. The dotted line shows the form of the finished thread.—*September 1st*, 1927.



Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Diesel Engine Users Association.—Caxton Hall, Westminster, London, S.W. 1. Paper, "Some Fuel Experiments in a Mechanical Injection Oil Engine," by Mr. E. L. Bass.

Junior Institution of Engineers.—39, Victoria-street, Westminster, London, S.W. 1. Lecture, "Lubrication," by Professor Edwin Edser. 7.30 p.m.

SATURDAY, OCTOBER 8TH.

Electrical Power Engineers' Association: Southern Division.—Hotel Cecil, Strand, London, W.C. 2. Annual dinner. 5.30 for 6 p.m.

MONDAY, OCTOBER 10TH.

Institute of Metals: Scottish Local Section.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Address by the Chairman, Mr. S. E. Flack. 7.30 p.m.

Institute of Transport.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Presidential address, "Main Line Railway Electrification," by Mr. Roger T. Smith. 5.30 p.m.

Institution of Automobile Engineers: Western Centre.—Merchant Venturers' Technical College, Bristol. Presidential address, "The Influence of the Automobile User upon the Automobile Engineer," by Major E. G. Beaumont. 6.45 p.m.

TUESDAY, OCTOBER 11TH.

Institute of British Foundrymen: Lancashire Branch, Burnley Section.—Municipal College, Burnley. Paper, "Core, and Coremaking," by Mr. T. G. Hilton. 7.15 p.m.

Institute of Marine Engineers.—85–88, The Minories, Tower Hill, London, E. 1. Paper, "A New Form of Insulating Material for High Temperatures," by Mr. A. F. C. Timpson. 6.30 p.m.

Institution of Electrical Engineers: Scottish Centre.—Electrical Engineering Lecture Room, 149, Royal Technical College, Glasgow. Opening address by the Chairman, Mr. D. M. MacLeod. 7.30 p.m.

Institution of Heating and Ventilating Engineers.—Caxton Hall, Caxton-street, London, S.W. 1. "Atmospheric Pollution," by Dr. J. S. Owens. 6.45 p.m.

Manchester Geological and Mining Society.—Queen's Chambers, 5, John Dalton-street, Manchester. Annual general meeting. Paper, "Notes on Indian Mining, Experiences on an Indian Colliery," by Mr. G. S. Caldwell. 4 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "The Iron-carbon Equilibrium Diagram from a Practical Point of View," by Mr. R. Whitfield. 7.30 p.m.

WEDNESDAY, OCTOBER 12TH.

Institute of Metals: Swansea Local Section.—Thomas' Café, High-street, Swansea. Address by the Chairman, Captain L. Taverner. 7 p.m.

Institution of Electrical Engineers: South Midland Centre.—Grand Hotel, Birmingham. Opening address, (*a*) "The Influence of Switch and Control Gear in Present-day Electrical Engineering," and (*b*) "The Importance of Psychology in Engineering Progress," by Mr. W. Wilson, Chairman. 6.50 p.m.

WEDNESDAY, OCTOBER 12TH.

Institution of Welding Engineers.—Caxton Hall, Westminster, London, S.W. 1. Presidential address, "Some Metallurgical Factors which may have an Influence on Welds, particularly of Iron," by Professor F. C. Thompson. 7.30 p.m.

Liverpool Engineering Society.—9, The Temple, Dale-street, Liverpool. Opening address by the President, Mr. Sterry B. Freeman. 6 p.m.

THURSDAY, OCTOBER 13TH.

Institute of Metals: London Local Section.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Chairman's address, "Works' Economics," by Mr. A. H. Mundey. 7.30 p.m.

Institution of Automobile Engineers.—Cavendish Café, Cornmarket, Derby. Derby Graduates' meeting. Lecture by Mr. W. A. Robotham. 7.30 p.m.

Institution of Civil Engineers: Birmingham and District Association.—Chamber of Commerce, New-street, Birmingham. Address by the Chairman, Major F. C. Cook. 6 p.m.

Institution of Mechanical Engineers: Yorkshire Branch.—Hotel Metropole, Leeds. Lecture, "Modern Conveying Machinery," by Mr. W. H. Atherton. 7.30 p.m.

Royal Aeronautical Society.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Lecture, "The Practical Side of Performance Testing of Aircraft," by Squadron Leader T. H. England. 6.30 p.m.

THURSDAY TO SATURDAY, OCTOBER 13TH TO 22ND.

Society of Motor Manufacturers and Traders, Ltd.—Olympia, London, W. 14. Motor Exhibition. 10 a.m. to 10 p.m. each day.

FRIDAY, OCTOBER 14TH.

Chemical Engineering Group.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "A Recent Development of Spray Drying," by Mr. J. A. Reavell. 8 p.m.

Institute of Metals: Sheffield Local Section.—Applied Science Department of the University, Sheffield. Chairman's address, "Science and Industry," by Mr. J. H. G. Monypenny. 7.30 p.m.

Institution of Engineering Inspection.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Electric Power Cables and Recent Developments," by Mr. C. M. Read. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "Problems Created by the Rapid Development of the Motor Car Industry," by Mr. F. A. Simpson. 7.30 p.m.

Manchester Association of Engineers.—The Engineers' Club, Albert-square, Manchester. Opening address by the President, Mr. S. H. Heywood, followed by a smoking concert. 7.15 p.m.

MONDAY, OCTOBER 17TH.

Railway Club.—25, Tothill-street, Westminster, London, S.W. 1. Paper, "Outdoor Interlocking Apparatus," by Mr. R. G. de Bray. 7.30 p.m.

TUESDAY, OCTOBER 18TH.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow. Papers: "The Industrial Engineer," by Mr. A. J. T. Taylor; "British Engineering Export Problems," by Mr. W. S. Murphy. 7.30 p.m.

WEDNESDAY, OCTOBER 19TH.

Newcomen Society.—Demonstration Room, Ground Floor, Science Museum, South Kensington, London, S.W. 7. Paper, "The Development of the Organ," by Mr. E. W. Anderson. 5.30 p.m.

THURSDAY, OCTOBER 20TH.

Institute of Metals: Birmingham Local Section.—The Engineers' Club, Waterloo-street, Birmingham. Paper, "Isotopes," by Dr. G. W. Aston. 7 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Presidential address, by Mr. Archibald Page. 6 p.m.

Institution of Mechanical Engineers: North-Western Branch.—The Engineers' Club, Manchester. Paper, "The Mechanical Testing of Materials," by Mr. R. E. Bailey. 7.15 p.m.

FRIDAY, OCTOBER 21ST.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Presidential address, by Sir Henry Fowler, K.B.E. 6 p.m.

SATURDAY, OCTOBER 22ND.

Institution of Municipal and County Engineers.—The Mansion House, Doncaster. Yorkshire District meeting. 11 a.m.

FRIDAY, OCTOBER 28TH.

Institution of Locomotive Engineers: Manchester Centre.—College of Technology, Sackville-street, Manchester. Paper, "Locomotive Performance and its Influence on Modern Practice," by Mr. E. C. Poultney. 7 p.m.